Research Report 1969

Addressing Point of Need in Interactive Multimedia Instruction: A Conceptual Review and Evaluation

Paul N. Blankenbeckler
Northrop Grumman Corporation

Thomas Rhett Graves
U.S. Army Research Institute

Richard L. Wampler
Northrop Grumman Corporation

November 2013

United States Army Research Institute
for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

Department of the Army
Deputy Chief of Staff, G1

Authorized and approved for distribution:

MICHELLE SAMS, Ph.D.
Director

Research accomplished under contract
for the Department of the Army by

Northrop Grumman Corporation

Technical Review by

Peter S. Schaefer, U.S. Army Research Institute
Jean L. Dyer, Consortium Fellows Research Program
Gregory Goodwin, U.S. Army Research Institute

NOTICES

DISTRIBUTION: Primary distribution of this Research Report has been made by ARI. Please address correspondence concerning distribution of reports to: Department of the Army, US Army Research Institute, 6000 6th Street Building 1464 / Mail Stop: 5610), Fort Belvoir, VA 22060-5610

FINAL DISPOSITION: Destroy his Research Report when it is no longer needed. Do not return it to the U.S. Army Research Institute for the Behavioral and Social Sciences.

NOTE: The findings in this Research Report are not to be construed as an official Department of the Army position, unless so designated by other authorized documentation.

REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy)	2. REPORT TYPE	3. DATES COVERED (from. . . to)
November 2013	Final	December 2012 - May 2013

4. TITLE AND SUBTITLE	5a. CONTRACT OR GRANT NUMBER
Addressing Point of Need in Interactive Multimedia Instruction: A Conceptual Review and Evaluation	W5J9CQ-11-D-0001
	5b. PROGRAM ELEMENT NUMBER 633007

6. AUTHOR(S)	5c. PROJECT NUMBER
Paul N. Blankenbeckler; Thomas Rhett Graves; Richard L. Wampler	A792
	5d. TASK NUMBER 359
	5e. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)	8. PERFORMING ORGANIZATION REPORT NUMBER
Northrop Grumman Corporation 3565 Macon Road Columbus, GA 31907 U.S. Army Research Institute for the Behavioral & Social Sciences 6000 6th Street Fort Belvoir, VA 22060-5610	

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. MONITOR ACRONYM
U.S. Army Research Institute for the Behavioral & Social Sciences 6000 6th Street (Building 1464 / Mail Stop 5610) Fort Belvoir, VA 22060-5610	ARI
	11. MONITOR REPORT NUMBER Research Report 1969

12. DISTRIBUTION/AVAILABILITY STATEMENT

Distribution Statement A: Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

Contracting Officer's Representative and Subject Matter POC: Thomas Rhett Graves

14. ABSTRACT *(Maximum 200 words)*:

The Army Learning Model (ALM) emphasizes a learner-centric approach to education and training and application of digital technologies to address learners' points of need. The point of need concept is focused both on the accessibility of information to support the learning process as well as designing learning materials to address individual differences in learners' experiences, background knowledge, and job-specific requirements. In this research we focused on determining how to apply instructional design techniques and tailored training strategies to address different learners' needs in the context of interactive multimedia instruction (IMI). This was accomplished on the basis of an extensive review of existing Army IMI to determine the relevance of various instructional designs and tailored training strategies to address point of need. Starting with a sample of *N* = 427 IMI modules, we reduced the sample (*N* = 179 modules) by focusing only on IMI relevant to Combat Arms/Maneuver, Fires, and Effects and Squad/Team Leaders. Findings indicated that much of existing Army IMI was designed to be applicable to the largest possible audience rather than address individual learners' needs. Here, we recommend principles and strategies that may be incorporated into the design of IMI to better address individual learners' needs.

15. SUBJECT TERMS

Learning Models, Multimedia Instruction, Tailored Training, Evaluations

			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT	17. ABSTRACT	18. THIS PAGE			
Unclassified	Unclassified	Unclassified	Unlimited	55	Dorothy Young 703-545-2316

Research Report 1969

Addressing Point of Need in Interactive Multimedia Instruction: A Conceptual Review and Evaluation

Paul N. Blankenbeckler
Northrop Grumman Corporation

Thomas Rhett Graves
U.S. Army Research Institute

Richard L. Wampler
Northrop Grumman Corporation

Fort Benning Research Unit
Scott E. Graham, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
6000 6th Street, Building 1464
Fort Belvoir, Virginia 22060

November 2013

ACKNOWLEDGMENT

We appreciate the collegiality and support of the Maneuver Center of Excellence (MCoE) Directorate of Training and Doctrine (DOTD), Fort Benning, GA, for this research. At MCoE DOTD, we would like to thank Mr. Edward B. Buckley and Ms. Lindsey L. Fredman for assisting us in collecting interactive multimedia instruction (IMI) source materials for our review; we also thank Mr. Chris Jaques, Mr. John Budd, and Mr. Chuck Taylor for their interest and support of our project at the MCoE. Finally, Mr. Jay A. Brimstin and Mr. James M. Morris deserve special thanks for identifying the relationship between point of need and interactive multimedia instruction as a topic in need of investigation.

We also thank the Fires Center of Excellence (FCoE) DOTD for their interest in and support of this research. In particular, Mr. Martin L. Huffmaster was essential in helping us obtain needed IMI source materials related to training at the FCoE.

For their assistance in tracking down IMI materials developed at Camp Dodge, IA, we thank COL Gregory O. Haygood, Jr., LTC Peter J. Quinn, CPT Jason T. Huffman, Ms. Danielle Orr, and Mr. Paul Outhier of the Iowa Army National Guard Distributed Learning Development Center (formerly, the Military Interactive Multimedia Instruction Center; MIMIC). Dr. Gary Rauchfuss (TRADOC Institute for Noncommissioned Officer Professional Development) and SGM Michael Coker also provided much needed information and assistance in tracking down IMI for review. Drs. Glenn Cobb, Jean Dyer, Peter Schaefer, and Scott Graham (ARI, Fort Benning, GA) provided valuable feedback and recommendations at critical points in the research effort.

Finally, we would like to acknowledge other key personnel who supported the effort. To ensure a thorough review and assessment of IMI materials we organized a multidisciplinary team to provide expertise. These individuals included operational researchers, military subject matter experts, educational and psychological researchers, computer programmers, and IMI developers. Each of these participants provided insights from their specific discipline that contributed to our final outcome.

ADDRESSING POINT OF NEED IN INTERACTIVE MULTIMEDIA INSTRUCTION: A CONCEPTUAL REVIEW AND EVALUATION

EXECUTIVE SUMMARY

Research Requirement:

The Maneuver Center of Excellence (MCoE) Directorate of Training and Doctrine (DOTD), Fort Benning, GA, requested research to address how the Army Learning Model's *point of need* (PON) concept could be applied in the design and development of interactive multimedia instruction (IMI) exemplars. A first step in that process was to review and evaluate existing Army IMI which is the focus of this report. Point of need refers both (a) to the accessibility of learning resources at any time or place and (b) to the ability of learning resources to provide instruction tailored to individual learners' level of knowledge and skill as well as their present professional requirements. This research focused on the latter challenge; namely, we reviewed existing Army IMI—one type of digital learning resource—and the current tailored training literature to identify design features and principles that could be incorporated into Army IMI and would enhance its ability to address the learning requirements of a specific audience. While we focused on IMI many of the principles and techniques we identify may be applicable to other types of digital learning resources.

Procedure:

To determine how to apply Army Learning Model (ALM) point of need and tailored training principles in Army IMI, the research team developed IMI evaluation criteria derived from the scientific literature and from an in-depth review of existing Army IMI. Starting with an identified pool of $N = 427$ individual IMI lessons, the sample was reduced to $N = 179$ IMI lessons for in-depth review. The reduction was based on selecting IMI that were relevant to Combat Arms/Maneuver, Fires, and Effects as well as to Squad/Team Leaders. The IMI we reviewed came from various sources, including: MCoE DOTD, Fires Center of Excellence (FCoE) DOTD, the Army Knowledge Online (AKO) My Training Tab (MT2), and the Distributed Learning Development Center (DLDC), Camp Dodge, IA. The sample was evaluated in terms of structural, pedagogic, and programming characteristics to determine how point of need and tailored training techniques could be applied to both existing and future IMI.

Findings:

The broad shift in educational and training philosophy represented by the ALM will require a parallel shift in how IMI is designed. Existing IMI was often produced to reach a general audience—using a one-size-fits-all design philosophy. Implementing point of need and tailored training on a large scale using existing IMI may be prohibitive in terms of cost and time because of the changes in instructional design philosophy introduced by the ALM. Even so, we were able to identify some low-cost and low-bandwidth design techniques and principles that can be incorporated into future IMI to better adapt content to Soldiers' individual learning needs. These involve whole-task assessment, detailed feedback to learners on their areas of difficulty,

allowing learners to make informed choices about how to progress through the IMI, multiple learning paths, part-task assessment with appropriate scaffolding for different learners' needs, and post training evaluation and feedback to help learners understand what they have learned and to enable them to plan future learning tasks. Some design features that enable Soldiers to select different learning paths have been incorporated into more recent Army IMI, such as 'A Day in the Bam.' However, these implementations often use complex and high-bandwidth multimedia features, which can limit accessibility. Moreover, they also tend to focus on teaching decision-action-consequence patterns, rather than focusing on the essentials of tasks that tend to be more cognitively or procedurally oriented.

Utilization and Dissemination of Findings:

This report presents our findings from the first phase of a two phase research effort. This report focuses on our evaluation of Army IMI and identification of learning principles and tailored training techniques to address point of need. A subsequent report will present proof-of-concept IMI exemplars incorporating the features we describe here, as well as the results of an experimental test of the IMI exemplars.

ADDRESSING POINT OF NEED IN INTERACTIVE MULTIMEDIA INSTRUCTION: A CONCEPTUAL REVIEW AND EVALUATION

CONTENTS

Addressing Point of Need in Interactive Multimedia Instruction: A Conceptual Review and Evaluation

Introduction

In 2011, *The Army Learning Concept 2015* (TRADOC PAM 525-8-2) was published, articulating a new learning model for Army training and education (TRADOC, 2011a). The new Army Learning Model (ALM) introduced *point of need* as a concept to guide the design and deployment of Army learning resources in order to better meet Soldiers' various learning needs and professional requirements. Point of need speaks to the many reasons Soldiers have for using Army learning resources; for example, they may want to strengthen a skill diminished by time or they have encountered a situation that demands they acquire a new skill. The central feature of point of need training is its specificity. Point of need training seeks to address a particular learning need for a particular audience at a particular time. This is in contrast to an approach that seeks to develop training that may be used to reach the broadest audience possible.

As one type of Army learning resource, which is fairly common, interactive multimedia instruction (IMI) can provide Soldiers nearly immediate access to learning material wherever and whenever their need arises. It may also be adapted to individual Soldiers' learning needs. This research explored ways to address Soldiers' specific learning needs and professional requirements by incorporating various design features and learning principles into existing and future IMI in order to emphasize a point of need approach.

Within the context of Army training, IMI has been used to address a variety of learning needs, such as (a) developing critical skills Soldiers need before entering courses, (b) supporting instruction within courses, (c) refreshing knowledge and skills related to particular topics after graduating from courses, as well as (d) providing comprehensive training materials covering complete courses (Straus, Shanley, Burns, Anish, & Crowley, 2009). Point of need is intended to expand the capabilities of IMI by specifying a constellation of requirements which indicate that questions concerning how and what is trained are as important as where and when it is trained. Army Learning Concept (ALC) 2015 states, "[l]earning is best achieved at the point of need and therefore must be accessible in a career-long learning continuum, rather than limited to specific timeframes or locations" (TRADOC, 2011a, p. 7). This statement implies that: (a) learners should be able to access a learning resource wherever and whenever it is needed, and (b) that the accessed learning resource is tailored to learners' current level of understanding and presents to them what they need to know to accomplish a specific job-related task and/or mission.

Point of need training can also be considered in terms of the depth and breadth of the information being presented and the purpose of the instruction. The concept may connote bite-sized chunks of content, designed to address only a very specific learning need, when a domain does not require great detail and depth of information to train properly. It may also point to more in-depth training when necessitated by the content domain and the needs of the learner. What point of need seeks to do is to define the specific needs of the learner and target those learning needs. When only considering point of need in terms of the duration of training, we may not fully consider the complexity of the topic we are seeking to train.

One way to address point of need is to explore design features and learning principles that may be applied to structure the IMI learning experience. Careful application of these principles can help in developing IMI that can address learners' needs at different times and places and with respect to the particular depth of knowledge they seek. To date, most Army research on IMI has focused on how to improve the features of courseware, such as its technical characteristics, production quality, or mode of delivery. Less research has focused on pedagogy or on applying tailoring techniques within IMI to better address individualized learning needs (see Giglio, 2009; Straus et al., 2009; Straus et al., 2011).

To address point of need requires taking a different perspective toward IMI—that is, a perspective that first emphasizes Soldiers' reasons for using the IMI, and second, the technological characteristics of the IMI. For the purposes of this research, we considered three point of need variations. First, some Soldiers may need to know the basic steps to complete a task, i.e., the *core* of a task. This type of training would have narrowly scoped content, but sufficient depth of information to execute a task. The point of need with core training would tend to be more procedural in nature, as in Call for Fire or Adjust Fire tasks. The training materials would cover the basic steps involved in executing the task, with supplemental information provided if necessary to support task execution. Other Soldiers may only need an overview of basic information for a topic or skill, i.e., *familiarization* with the subject domain. This type of training would be broad in scope, but have less depth of information than core training. Familiarization training would tend to address key concepts and more evaluative tasks, such as those involved in determining squad defensive positions in an urban environment. Still, other Soldiers may already have a good base of knowledge and skill, so the IMI must be able to address difficulties that arise for them as individuals, i.e., incorporating *tailored training* principles. A tailored training approach needs to be flexible with respect to the breadth and depth of information being presented. In other words, a tailored training approach may incorporate both core and familiarization. In addition, it would apply techniques to assist learners in being aware of their own areas of difficulty and helping them to make informed decisions concerning how to proceed through their training. Together, these types of point of need training likely cover a large portion of situations in which Soldiers would need learning materials to address their specific information or training needs, whether those needs concern new learning or refreshing existing knowledge and skills.

In order to design IMI to best meet a variety of needs, it should be able to address multiple levels of comprehension and experience, as well as meet Soldiers' present expectations and professional requirements. For instance, Dyer, Singh, and Clark (2005) found that One Station Unit Training (OSUT) Soldiers tended to require training that is more highly structured than did Infantry Officer Basic Course Soldiers, who benefited more from being able to control how and what they were learning. Learning resources designed to address point of need should incorporate features that allow the learner to exert varying degrees of control over what he or she is learning—an approach that accords with the ALM's learner-centric perspective. The ALM point of need concept presents a vision of future IMI that may better address individual differences in knowledge and skills and in desired learning outcomes (TRADOC, 2011a). As Dyer, Singh, and Clark (2005) noted: "careful thought should be given to computer based

training design to account for individual differences and to maximize learning on the part of all" (pg. 33).

Interactive Multimedia Instruction at the Point of Need

Although it is a concept finding new application in ALM, point of need has been studied in a variety of contexts to include library science (Trump & Tuttle, 2001; Lipow, 2003; Walsh, 2010), instructional design (Brown, 1997), and medical training (Harun, 2002), among others. Walsh (2010) applied Global Positioning System technology to provide library users with resource recommendations based on their location within a library and the topic of their search; the user's point of need was an informational need that was addressed in relation to where they were within the library. Brown (1997) conceptualized point of need in terms of accessibility of internet content, i.e., the anywhere/anytime view of point of need that was prevalent in the 1990s. However, she also drew in elements related to students self-pacing within online instruction, exploring topics of interest in greater depth, and skipping over topics they felt were already understood well. Finally, in the context of medical training, Harun (2002) described point of need as a targeted application of a limited amount of information; just what the learner needs to know given his or her present activity. The ALM point of need concept seems to cover the breadth of concerns that emerge in previous research on point of need, as it focuses both on factors related to time and place—a delivery concern—and on tailoring to specific learners' needs—a training and education concern with design implications.

In a recent video, *Army Learning Concept 2015: Thinking Soldiers – Learning Army!* (TRADOC, 2010), TRADOC provided striking examples of what it envisions for IMI designed to address point of need. In the first example, a young infantry Soldier is accessing point of need IMI on room clearing operations, using a personal digital device. His fire team is conducting collective training using precision room clearing techniques. He reviews these materials immediately prior to joining his fire team in live training. In the second example, a medical specialist is en route to an incident on an aero medical evacuation helicopter. The Soldier accesses IMI for medical treatment procedures on her personal digital device before she arrives at the site. When she arrives she moves quickly employing her recently refreshed skills to treat casualties.

These examples vividly illustrate how the Army anticipates applying digital technologies to accomplish aspects of point of need training as the ALM is implemented. Digital learning resources can be effective and efficient tools to address requirements of accessing and leveraging training wherever and whenever it is needed. Also, given that digital learning resources are often completed by individual learners, they provide a means for addressing a critical aspect of the point of need concept: tailoring training to fit individual Soldiers' needs.

Impact of IMI within the context of the ALM

IMI that can address point of need is significant to supporting TRADOC's goal of having Soldiers and leaders who are "fully prepared to prevail in complex, uncertain environments" (ALC 2015, TRADOC, 2011a, p. 19). While the ALM is changing how digital media and digital technologies are being used in the Army, it may also initiate changes in organizational practices

to support the emerging learning environment. For instance, Straus et al. (2011) found that training policy, training circumstances, and student characteristics were often the most significant factors related to long-term knowledge retention. Point of need IMI can support implementation of ALM's learner-centric environment across three main learning contexts (a) context-based, collaborative, problem-centered instruction, (b) blended learning, and (c) distributed learning (dL). IMI will need to be adapted, either by design or by application to fit these various learning contexts.

Becoming learner-centric. Soldiers who spent more time working on IMI retained more knowledge over time (Straus et al., 2011). It is noteworthy that the time Soldiers are able to invest using IMI for learning is often under the control of their commander. Straus et al. noted that commanders who permitted their Soldiers to use duty time for study, review, and course preparation, also had Soldiers who spent more time using IMI materials to learn. Soldiers who were only able to use IMI on their own time used IMI less, and retained less knowledge. A clear implication of this finding is to shorten IMI modules so they can be completed within periods of opportunity during the duty day to enable learning activities to be interspersed with other duties.

The future learner-centric environment must provide context-based, collaborative, and problem-centered instruction. These characteristics are intended to reduce the Army's reliance on instructor-centered lectures, and replace it with more learner-centered instructional methodologies. This shift in instructional methodology may include self-paced, technology-delivered instruction outside the classroom and may take several forms, including IMI and other types of dL such as mobile applications (apps), gaming, wikis, blogs, social media postings (e.g. Facebook), or other media that allow creation and exchange of user-generated content.

Within a learner-centric environment of this type, learners may use IMI to develop a foundation for, be introduced to, or familiarized with new knowledge and skills. Depending on the intent of training designers and the identified needs of students, applying the point of need concept may not always require materials to be developed that go into great depth on any single skill. This IMI could instead seek to give learners an understanding of the breadth of concepts and tasks involved in a domain, and the knowledge of where and how to seek out supplemental information to facilitate them in seeking greater depth of understanding at a later time. This IMI would be designed to familiarize learners with a topic domain.

Point of need IMI could also be used to refresh or reinforce existing knowledge—as is presented in the TRADOC video, 'Thinking Soldiers, Learning Army!' The IMI could be designed to first assess a Soldier's current proficiency and then target the learning content to address identified deficiencies. With respect to IMI design, using scenario based assessments with detailed feedback, systematically varying training activities within the instructional design, and applying tailored training techniques to target user preferences and knowledge and skill levels may support the learner-centered ALM approach (see Schwartz, Brophy, Lin, & Bransford, 1999).

Blending IMI with residential courses. As not all IMI is used by learners outside of a residential course, applications of the point of need concept to IMI used in blended learning contexts should also be considered. Blended learning has been most frequently defined as a

combination of online or technology-delivered instruction and face-to-face instruction (see Graves & Bickley, 2009). However, blended learning is more than an amalgam of a good trainer, a cooperative peer group, and IMI. Blended learning is intended to merge the efficiencies and effectiveness of self-paced, technology-delivered instructional activities with those of the expert facilitator. It can also harness the benefits of peer-to-peer interaction within a small group (Romiszowski, 1988). Blended learning is intended to leverage the strengths of digital-age learners and engage them through the use of multimedia and/or game-based scenarios, while still retaining the benefits of face-to-face discussions and knowledge sharing (Jones & Bronack, 2007). IMI applications used in a blended learning setting are likely best designed to be less-structured and focused around collaborative learning activities. This type of design would better allow the Army to avail itself of the advantages of the face-to-face learning situation, while also incorporating learning technologies to support learning.

Blended learning may also potentially be used to decrease learning times. Research in the use of blended learning indicates that students may attain a 30% decrease in the time that it takes to learn with no decrease in effectiveness (see Fletcher and Chatham 2009; as cited in TRADOC, 2011a). The "guide on the side" instructor requires increased proficiency in communications skills, needs increased mastery of the associated knowledge and skills, and must be skilled in the incorporation and use of appropriate media and technologies throughout training. It should also be noted that increased efficiency seems to be attained most often when the technology-delivered instruction, IMI or other forms of dL, is designed employing established learning principles coupled with appropriate learning content (Fletcher & Chatham, 2009).

Distributed learning and accessibility. Finally, IMI is expected to play a key role in all future Army life-long learning models (TRADOC, 2011a). One critical reason for this is its accessibility. Through its varied forms, IMI provides the capability to deliver learning content at the point of need, when and where the knowledge and skills are required to be introduced, refreshed, enhanced, practiced, or mastered. However, to meet this challenge, IMI products must be up-to-date, easily accessible, and engaging. Content available to the Soldier must be expanded, broader and more inclusive of a wider variety of experience, tasks, skills, and knowledge levels. The content of IMI products must be tailorable to the learner's current level of understanding and needs. For this to be possible the learner's needs and requirements must be accurately assessed, and the training delivered must be tailored to meet the Soldier where he or she is.

While the implementation of ALM is well underway, it has varied across TRADOC. Some institutional courses are already learner-centric, having implemented many of the ALM adult learning concepts and principles, such as facilitation and collaborative learning. Recent research has indicated that a number of courses are already applying tailored training to address individual or small group student needs. Even so, many other courses—even those that exhibit some ALM learner-centric characteristics—seemed to remain centered on trainers and institutions, rather than on students (Dyer, Wampler, & Blankenbeckler, 2011).

It is a similar situation with respect to IMI. Some IMI was developed well before ALM began to be implemented. This older IMI exhibits design characteristics that tend to be

standardized and sequential. More recent IMI has sought to incorporate more interactive and media-rich features, many with less sequential narrative structures such as branching storylines. Yet, even this current IMI is not necessarily designed to target specific learners' needs, even if the learner can interact with the media. As ALM is implemented, IMI will likely continue to develop in tandem with institutional training as they become ever more blended in schoolhouse courses.

Stand-alone, computer-based learning via the internet has supported Army initiatives focused on life-long learning, self-development, as well as knowledge/skill acquisition and maintenance (Graves, Rauchfuss, & Wisecarver, 2012). It is clear that the internet will continue to be relied on as a tool to deliver information and training materials. In recent years, internet access has expanded from desktop computers to also include mobile devices, such as smart-phones, tablets, and digital readers. In the future, the cloud and other approaches to centralized data management and delivery will continue to support development of ever higher quality, more immediately accessible and up-to-date learning resources.

Although the ALM is part of a Campaign of Learning that could potentially revolutionize how the Army trains Soldiers and leaders, it is a slow-going revolution. The ALM is being implemented in-stride (TRADOC, 2011a), and many simultaneous steps toward implementation are underway. For IMI, Army Knowledge Online (AKO) now provides enhanced access to the Army Training (and Education) Network (ATN). In late February 2012, the Army migrated approved IMI courses and other training materials to the MyTraining Tab (MT2) of the ATN, as a step toward creating a "single portal to digital resources." To support their training programs and as a transitional step, many Army Training CoEs already provide access to training materials, training references, and IMI courseware.[1] It seems that broad accessibility is already addressing the wherever/whenever needed aspect of point of need.

With the vast array of learning resources being developed and currently available, Soldiers need a way to manage their individual learning initiatives (Graves, Rauchfuss, & Wisecarver, 2012). Straus et al. (2011) reported that Soldiers learning success was increased by having a shorter lag time between completing the IMI phase of a course and starting the residential phase. It would seem that consistent, focused learning needs to be spaced appropriately to enhance Soldiers' learning and longer term retention of knowledge and skills. Soldiers may be supported by tools like the Army Career Tracker to find the optimal time to complete IMI prior to beginning a residential course, or to follow a long-term learning path (Gary Rauchfuss, personal communication, 23 April, 2013).

Addressing Problems with IMI Reuse/Repurposing

[1] The IMI courseware available on CoE sites includes materials not yet migrated to the ATN site, such as IMI that is in development or not yet posted to the ATN catalog and library or held for use in proponent-controlled functional or leader courses. For example, a CoE-improved access portal can be found on the Fires Center of Excellence (FCoE) Reach Back/Reset Training site at https://firescoe.sill.army.mil/. The FCoE site provides access to an extensive resource library of training materials and references for all Field Artillery (FA) and Air Defense Artillery (ADA) military occupational specialties and training courses.

Another significant issue that has arisen in the development and deployment of Army IMI is that of reuse. In our research, we considered the feasibility of reusing/repurposing existing IMI to better fit the ALM learner-centric design philosophy and learners' specific needs. In historical context, the intent to reuse IMI has been integral to the development process. In January of 1999, the Executive Branch of the United States (U.S.) Government recognized the impact of the computer on training and acknowledged a revolution in learning when President Clinton signed Executive Order 13111 (Clinton, 1999). Key tenants of this directive were the mandates to "promote and integrate the effective use of training technologies," establishment of a mechanism for development of standards for training software, and a desire for both efficiency and economy through the promotion of "reusable training component software." The Department of Defense (DoD) had taken steps two years earlier through the Office of the Undersecretary of Defense for Personnel and Readiness to establish the Advanced Distributed Learning (ADL) initiative (Fletcher, 2010). A stated goal of the ADL initiative was to assist the Armed Forces to make learning available, on demand, anytime and anyplace.

Army and DoD interest in the usability and reuse of software components, including elements of IMI, can be traced to the late-1980s and lessons drawn from the European, Japanese, and U.S. commercial software industry. These commercial organizations had demonstrated economy and efficiency with the reuse of existing software. Additionally, they had demonstrated significant potential for increasing engineering productivity and rapid marketing of new software products and version improvements, while maintaining high system quality as well as decreasing the cost while building and maintaining large, software-intensive systems (Software Productivity Consortium Services Corp., 1993).

Indeed, some early goals of ADL seem to be coming to fruition. With the broad availability of miniaturized computing platforms in the form of small robust tablets and highly capable *smart* cellular telephones, the envisioned portable user interface devices are reality. The capabilities and features of these platforms seem to expand exponentially as new models are rapidly introduced into the market. The standardization and structure of training media directed by the requirements of the Sharable Content Object Reference Model (SCORM) (DoD, 2011) provides that components of dL materials developed for the military audiences will be structured to be portable, durable, and reusable.[2] These components are identified as Sharable Content Objects (SCOs). A SCO represents the lowest level of granularity of a learning resource that a learning management system (LMS) should track. The SCORM requirements do not impose any particular constraints or minimum requirement on the size of a SCO. A SCO may be a single graphic on a single web page, or it can be a collection of web pages. However, a SCO should be a single unit, independent of its learning context and reusable in a similar or new context. To achieve such reusability, a SCO should be self-contained and not reference or link to other SCOs. SCOs should be available through the source files of their parent courseware.

The implementation of a Content Object Repository Registration/Resolution Architecture (CORDRA) for cataloging SCOs in the ADL registry may soon provide improved visibility to

[2] SCORM is a standard for a technical framework to enable the use of Web-based e-Learning content across multiple environments (e.g., LMSs). SCORM defines how individual instruction elements are combined at a technical level and sets conditions for the software needed to use the content. For further explanation, see "SCORM 2004, 3rd Edition" (Advanced Distributed Learning, 2008).

more readily facilitate reuse or repurposing of SCOs. With these advances, it would seem that with the addition of an improved network and an intelligent tutor, Soldiers should soon be able to engage in training and learning tailored to their wants and/or needs at any time and place. Indeed, Hu, Graesser, and Fowler (2010; as cited in Fletcher, 2010), envision a future environment in which the user, through a smart device, will access tailored learning. They argue that this access and learning would not only be through pre-specified lessons (existing, purpose-built IMI), but in a manner akin to the age old tutorial practice of a student and a mentor working together to enhance knowledge and refine the skills of the student. What differs in the scenario they envision is that the human mentor would be replaced by a computational device—accessing, selecting, organizing, and delivering SCOs drawn from a vast repository through a networked information infrastructure. Additionally, these smart devices acting in a system of systems would also support assessment of student progress, determine the need for prerequisite or foundation knowledge, certify accomplishments, and forecast skill and knowledge decay to support retraining. The knowledge management system would trigger remediation, retraining, reinforcement or scaffolding at appropriate times, as well as provide progressively more advanced training to improve knowledge, refine skills, or respond to the student's desire for exploration of new knowledge.

The Continuing Challenges of Reuse and Repurposing of IMI. Many of the modular approaches to IMI development and delivery were challenged by Shanley et al. (2009) in a study of the challenges of IMI reuse for the Army Distributed Learning Program. Shanley et al. found that significant savings or returns from dL reuse are exceptions. In fact, only 25% of the training development organizations estimated positive return on investment through reuse. Most organizations recognized lower than expected returns and 35% reported no savings or a loss (i.e. time, labor, dollars). Most organizations noted significant technical issues, unexpected problems, and complexities of reuse. Some of the obstacles reported include: issues with metadata or repositories, lack of strategic planning for reuse, cultural issues blocking implementation (e.g., "not invented here" attitude), legal or security issues, lack of training on tools needed for repurposing materials, failure of collaboration between agencies, difficulty changing established design processes, and difficulty defining what constituted a SCO. Given these concerns, some organizations felt that it was easier, cheaper, or more efficient to create new content rather than find, review, validate, and repurpose existing learning objects/SCOs.

Even though organizations conformed with SCORM requirements for developing instructional content, the lack of firm defining criteria for a SCO led to numerous challenges when trying to reuse dL. Shanley et al. (2009) reported that most successes with reusable learning objects/SCOs typically involved the repurposing of modules or larger chunks of content. The examples provided by training development organizations indicated that modules were taken from existing courses and repurposed into smaller stand-alone learning packages in order to reach larger audiences. However, participating organizations described greater success with reuse of entire courses instead of reusable learning objects/SCOs or modules and chunks. When organizations decided to reuse courseware, they often recognized that the courses and learning materials were of interest across student populations and courses. Frequently this reuse of courseware required running the courseware on a new LMS. The transition was often far from transparent. Fine adjustments were almost always required to make these reused learning objects compatible with the new LMS.

In addition to examining the current state of reuse, Shanley et al. (2009) also examined trends that could forecast or indicate a probability of increased reuse. The study reviewed industry and trade information on the demand for and sales of learning content management systems (LCMS). LCMS software provides training developers with authoring applications, data repositories, delivery interfaces, and a variety of administrative tools to aid in the management of e-Learning content. Low sales and demand data for available LCMS seem to indicate that few organizations are actively pursuing or planning extensive object reuse. Organizations seemed disinclined to invest in the required tools for future reuse efforts.

Rationale and Methodology

Given that little research has investigated applications of the point of need concept in Army IMI, we undertook this research effort to explore these potential applications. We sought to determine possible ways point of need could be applied to existing IMI as well as to the development of future IMI. The objectives of this research were to:

- Review existing Army IMI developed for the Maueuver, Fires, and Effects (MFE) domain in order to identify IMI that could address the specific needs of new Squad/Team Leaders;[3]

- Evaluate the characteristics of selected IMI for modification to three point of need variations: familiarization, core, and tailored training; and

- Propose techniques to address applications of point of need in reusing existing IMI and in developing future IMI.

While conceptual, organizational, and technical barriers can disrupt the process of reusing or modifying existing IMI, we sought to review existing Army IMI to determine if it could be modified to address point of need as well as to identify design features and tailored training techniques that could potentially be incorporated into existing and/or future IMI. The focus of the current report is conceptual and evaluative, reporting on the work we did prior to beginning development of point of need IMI exemplars. The IMI exemplars and the results of experiments testing the different point of need variations will be presented in a subsequent report. This report focuses on our review and evaluation of current Army IMI, and the design features and tailored training techniques we view as amenable to a point of need IMI training context. The results reported here emerged from lessons we learned when investigating candidate IMI courses for reuse/modification to various point of need formats.

Identifying IMI for Evaluation

For the purposes of this report, we used the following definitions to identify different levels of courseware components:

[3] We limited our review to IMI relevant to Maneuver, Fires, and Effects, and Squad/Team Leaders in order to make the review executable. A census-type evaluation of all Army IMI would have been too broad-ranging to execute effectively.

- *Course* – An entire block of training that contains all materials and content for the given subject area. A course may contain multiple lessons, tests, reference materials, navigation instructions, etc. As an example, a course covering the subject area of "map reading" may contain multiple lessons consisting of plotting grid coordinates, colors on the map, topographic features, legend, etc.

- *Lesson* – A block of instruction that covers a specific subject, not a broad subject area. In many Army courses, a lesson would cover a specific task, such as "plot grid coordinates," or "identify map symbols from the legend." The lesson would consist of the training material, could contain checks on learning, or a test to assess learning for that specific subject.

- *Module* – Within a lesson, instructional material is frequently organized and grouped into smaller chunks, which we consider to be modules. Each module is generally a small chunk of learning that covers the learning objectives and possibly includes a quiz or check on learning. The module could be considered the smallest stand-alone block of instructional material.

- *Sharable Content Object (SCO)* – IMI developers have interpreted SCO to mean many different things. In some instances, SCO refers to merely a single graphic or an audio file attached to an instructional page, while in other cases it could mean several pages of content. Here, we defined a SCO as any piece of IMI that is smaller than a self-contained chunk of learning.

Given that a comprehensive review of all Army IMI was not feasible, we worked with the Directorates of Training and Doctrine (DOTDs) at the Maneuver Center of Excellence (MCoE), Fort Benning, GA, and the Fires Center of Excellence (FCoE), Fort Sill, OK, to obtain IMI for review. In addition, we identified other IMI available on the Army Knowledge Online (AKO) My Training Tab (MT2) site. While obtaining IMI was an essential aspect of our review, access to source files containing original graphics, text files, reference materials, and narrations was critical to explore how we could repurpose and reuse the materials to address point of need. The MCoE and FCoE DOTDs, as well as the Distributed Learning Development Center (DLDC), Camp Dodge, IA,[4] provided available files for selected materials. Additionally, to assist in determining tangible, point of need targets for training, the MCoE provided a list of 29 individual tasks that represent competencies required for small unit leaders. These tasks ranged from operator maintenance tasks such as "Maintain a 240B Machine Gun" to complex leader tasks such as "Troop Leading Procedures." These tasks were generally centered on practical knowledge and skills required by section, fire team, and squad leaders in the preparation, planning, and execution of successful combat operations. From this list, we were able to refine our focus to a narrower skill set.

In the process of our sample selection, we reduced the pool of $N = 427$ IMI examples to $N = 179$ by focusing on IMI relevant to MFE and to new Squad/Team Leaders. Using the reduced sample, we developed a scheme to classify IMI based on characteristics related to its potential reusability in a point of need context. In tandem with this analysis, we reviewed the existing tailored training literature to identify principles that could be applied in the design of IMI to improve on current interactivity and tailoring found in existing IMI courseware. Ultimately, this research effort was exploratory and sought to point the way ahead for

[4] DLDC was formerly known as Military Interactive Multimedia Instruction Center (MIMIC).

implementing point of need concepts within current and future IMI repurposing and development.[5]

From our review, it was clear that the Army has invested extensively in IMI and other distributed learning (dL) resources. For example, prior to the activation of the MT2 site, 289 IMI courses were available for viewing through public access of the Reimer Digital Library (https://rdl.train.army.mil/soldierPortal/).[6] Courses were cataloged with each course or domain assigned a specific number. For example, "Enter a Building during an Urban Operation" was assigned number 071-326-0513. The first three numbers represent the proponent; in this case, the proponent is the Infantry. Many existing IMI modules are identified by the proponent-assigned individual or collective task number. Of these 289 courses in the Reimer Digital Library, 196 were categorized under the Infantry proponent number of *071*; three are categorized under the Field Artillery proponent number of *061*; two are categorized under the Armor proponent number *171*. The remaining courses were spread throughout the Operations, Support, and Effects and Force Sustainment proponents. Many of these courses were migrated to the MT2 site and proponents, such as the FCoE, have made access available to additional courses through CoE-administered sites. Indeed, the Army possesses a significant quantity of IMI and dL materials. However, the pedagogic approaches of many existing IMI tend toward a sequential, book-like structure. This type of structure would not readily facilitate application of the ALM point of need learner-centric techniques because of its linear design and intended applicability to a general audience.

The MCoE and the FCoE provided a selection of current IMI materials for examination and consideration. This selection was also supplemented by a review of IMI posted on the MT2 site that was relevant to MCoE. A summary of these materials is in Table 1. A more complete listing of IMI materials reviewed for this effort is provided in Appendix A.

[5] In a subsequent report, we will present IMI exemplars of different point of need variations as well as the tailored training techniques we describe here.
[6] This hyper link has been redirected to the MT2 site.

Table 1

Summary of IMI Courses Reviewed for Potential Reuse

Course	# of Lessons
19K (Armor Crewman) Advanced Leader	20
19K MOS Transition	30
19D (Cavalry Scout) Advanced Leader	21
19D MOS Transition	34
13F (Fire Support Specialist) MOS	28
Stand-Alone Lessons (CD-ROM)	
Small Unmanned Ground Vehicle (SUGV) Leaders	
SUGV Employment for Leaders (Platoon)	
Welcome to Jumpmaster	
Welcome to Pathfinder	
A Day in the Bam- introduction to Virtual Experience Immersive Learning Simulation (VEILS)	
Stand-Alone Lessons (MT2 Site)	
Engage Targets During an Urban Operation	
Prepare a Range Card for a Machine Gun	
Perform a Function Check on an MK19 Machine Gun	
Unload an MK19 Machine Gun	
Mount a Night Vision Sight, AN/TVS-5, on an MK19 Machine Gun	
Prepare Positions for Individual and Crew-Served Weapons During an Urban Operation	
Enter a Building During an Urban Operation	
Correct Malfunctions on an MK19 Machine Gun	

Reviewing/Evaluating IMI

At the outset of the review process we determined that selected courseware would be examined in terms of three major criteria: (a) relevant and current subject matter content; (b) design features; and, (c) if the courseware was compiled in a manner that allowed it to be separated into piece parts for reuse. This third point is a significant concern if point of need is to be applied using existing Army IMI. Often, separating IMI into piece-parts can render the individual parts inoperable, undermining a reuse/repurposing effort.

Reviewers included operational researchers, military subject matter experts, educational and psychological researchers, computer programmers, and IMI developers. These reviewers examined the IMI courseware from their individual areas of expertise. At least one reviewer examined each piece of selected IMI courseware in terms of the three major criteria. In cases when a single reviewer could not completely evaluate a piece of IMI, multiple reviewers were involved. There was great variability in time (approximately 10 minutes to over 2 hours) to complete a review for each piece of IMI. This was due to varying sizes of IMI courses; that is, the number of lessons, modules, and supplemental material that had to be evaluated.

The initial step was to examine scientific research and technical references to determine viable methods for evaluating IMI in order to develop an effective procedure for the evaluation (e.g., Stoyanov & Kirschner, 2007). The evaluation addressed a variety of related, yet independent, characteristics of IMI concerning their potential for tailoring, potential for reuse, and potential for applications of learning science to address the point of need concept. The goals of the evaluation were to:

- Determine a strategy for categorizing existing IMI that would support identification of materials and components for potential tailoring and reuse.

- Determine suitable criteria for determining the potential for IMI tailoring and reuse.

- Identify a group of learning principles, instructional techniques, and methods suitable to address point of need in existing and future IMI.

The initial list of evaluation criteria was developed on the basis of similar processes described in Stoyanov and Kirschner (2007); Kalyuga, Chandler, and Sweller (1999); Metzler-Baddeley and Baddeley (2009); Bell and Kozlowski (2002); and Eiriksdottir and Catrambone (2011). From these sources, we derived an initial list of criteria, which are presented in Appendix B. As the evaluation process was iterative, we found our criteria needed to be modified as we progressed. Many of the criteria we had initially identified were not applicable to the IMI materials we evaluated. As we proceeded, the evaluation criteria were reduced. Table 2 presents the set of criteria most relevant to the Army IMI we evaluated.

Table 2
Initial Criteria for Evaluating Existing IMI and Associated Point of Need Considerations

Criterion	Description	Point of Need Design Considerations
Complexity/Depth of Information Presented	Is there sufficient content to provide the desired coverage of the subject area, especially when attempting to form the different points of need training material?	Can aspects of the information present be down-selected to focus on a specific learning need?
Viable Examples	How are examples being used and are there single or multiple examples? Multiple examples may be better to allow Soldiers to generalize principles by deriving consistent patterns across examples (cf. Schwartz & Bransford, 1998).	Can existing examples be restructured or reordered to apply tailoring principles, such as backward fading? Are the examples contextually relevant to the target audience?
Narrative Flow	Does the narrative of the training make sense? Do instructional pages that come later logically build on what came before?	Would additional IMI development be required to produce a coherent narrative when restructuring the existing IMI?
Presentation is Focused vs. Diffuse	Do the parts have a clear topical focus, or does the training meander?	Are there elements of the existing IMI that can be removed to focus the development of topics?
Outcome Meets Goal	Are training goals achieved by the end of the training? Does the IMI deliver on what it promises to deliver?	What aspects of the existing IMI need to be removed, modified, or added in order to address the identified need of a specific audience?
Grouping of Content	Are the modules and information grouped in a way that makes sense and provides a coherent structure (i.e., support development of schemas)?	Is the essential information present to address the depth of knowledge required by the specific audience to accomplish the task being trained?
Timing	Would a Soldier be able to develop understanding of one learning point before the next one is presented? Are there logical points at which a Soldier can take a break from what they are learning?	Is it possible for a learner to jump around in the IMI to focus only on topics that are relevant to them at a specific point in time?

After identifying the most salient criteria for evaluation, we categorized IMI materials and components for modification to a point of need format. This process was supported by some research team members' previous experiences developing multimedia courseware. The team examined characteristics of existing IMI that would contribute to a meaningful IMI categorization. The goal was to identify criteria that assisted in selecting IMI for reuse as familiarization, core, or tailored training IMI.

The process initially identified multiple characteristics of IMI. These characteristics consisted of administrative details, such as title and time; pedagogical information such as training taxonomy, terminal, and enabling learning objectives; and technical characteristics that included visual media and text file details.

Although the initial goal was to examine IMI to identify modules with characteristics favorable to modification to a point of need format, many of our expectations were not met that would allow us to select from a large pool of IMI for reuse/modification. This limitation emerged from our concerns that the IMI must be able to meet the needs of a predetermined, very specific audience. In our case, we were focusing on new squad/team leaders (i.e., soon to be promoted Specialists/Corporals and Sergeants). We needed to take a step back in our evaluation process to look at more fundamental issues guiding selection. Many IMI products reviewed did not consistently contain the depth of information, repurposable graphics and images, viable examples in the instructional material, and/or appropriate tests to appropriately target a specific audience. Rather than work from a more complex typology based on many criteria (i.e., those described in Table 2), we decided to initially focus only on those factors that could most practically be used to guide selection and then move toward the more complex evaluation as we were able to down-select our sample of IMI.

The final selection criteria focused on broader characteristics that would more readily indicate the potential of particular IMI for modification to a point of need training format. These characteristics were:

- Source file availability,
- Doctrinal accuracy and currency of content, and
- Chunks of content that could be used to satisfy the point of need requirement, with respect to the criteria described in Table 2.

This simplified approach is depicted in Figure 1. Rather than filtering through myriad criteria, it was apparent that a few central characteristics were sufficient to identify IMI that had potential to be modified to a point of need format, which we could then evaluate in terms of the criteria described in Table 2.

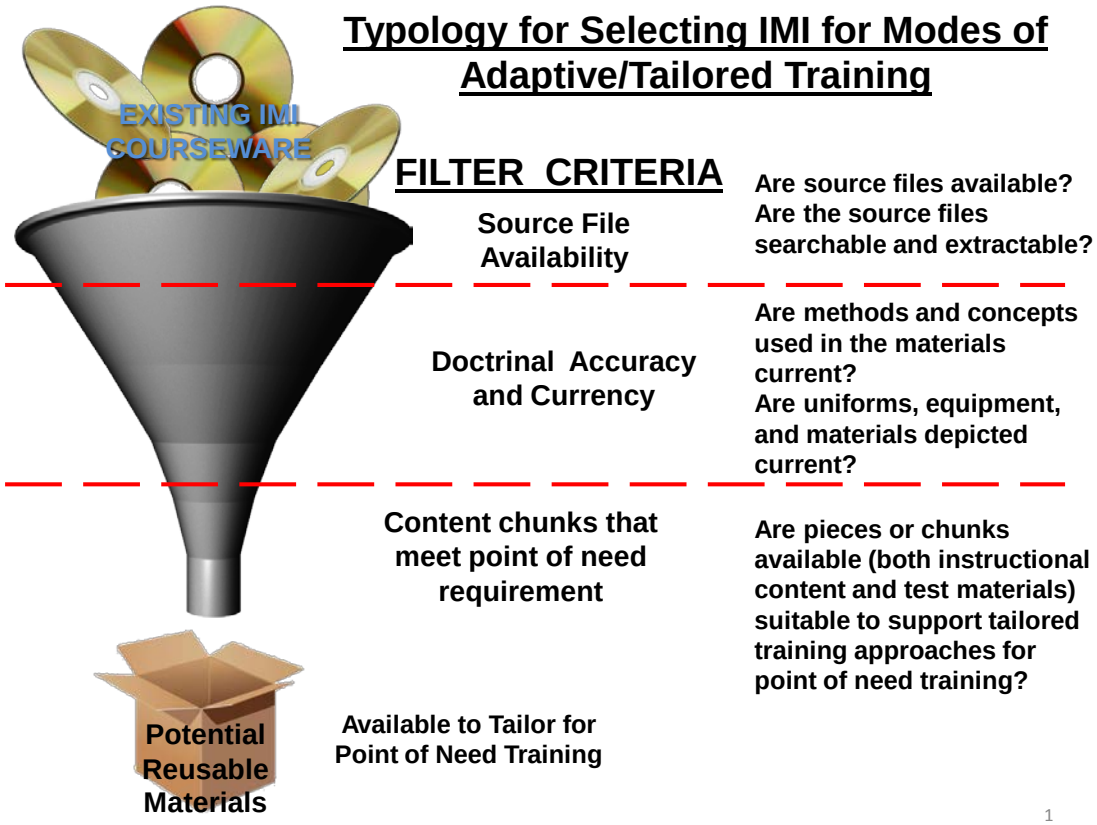

Figure 1. **Typology for Selecting IMI for Modes of Adaptive/Tailored Training.**

Observations Emerging from the Evaluation

Structural Characteristics of Reviewed IMI

Our initial review of the IMI products indicated a wide variety of pedagogical approaches and media uses. However, most IMI appeared to be structured for familiarization or as an introduction to knowledge, tasks, or skills. Information, knowledge, and skills were seldom presented in the context of more than a single situation. Checks on learning or module and section tests closely followed the presentation of information. The same questions used as knowledge checks were often used throughout the lessons and appeared as final assessment questions. Seldom were opportunities provided to permit the application or practice of information in the context of a whole task.

The ALM concept of using existing IMI for "just in time" and "as needed, when needed" may be unattainable through existing courseware when the focus is on tailoring to the differing needs of particular individuals. For example, the 13F Fire Support Specialist site available through the FCoE currently contains over 80 hours of quality, doctrinally correct, training materials accessible to an ambitious student of the art of fire support. However, the more experienced 13F specialist, Infantry squad leader, tank commander, or reconnaissance section sergeant looking for a quick (i.e., a few minutes) refresher of core knowledge concerning call-

for-fire skills or desiring to familiarize himself in a short period of time with mortar registration requirements, would be frustrated with the difficulty of locating this content in the existing IMI courseware.

Some of the courseware provided by the FCoE proved to be an exception to this generalization due to the organization of the materials. The lessons within these courses were typically organized into five distinct parts or elements:

- *Introduction* – provided administrative information and the organization of the material.
- *Tutorial* – provided primary training on how to perform the task and conveyed the needed knowledge, tasks, and skills.
- *Demo* – demonstrated an expert performing the task from start to finish.
- *Guided Practice* – guided the student through the complete performance of the task.
- *Knowledge Review* – provided a review of the key performance measures in the lesson and provided a check on learning or test for assessment.

This crawl-walk-run approach to training contrasted with the three-frames and a check on learning approach used in a number of other IMI lessons. Additionally, some course materials used role playing or followed the role of a character in a situation. These products engaged the learner using video or animation, providing an environment that comes close to being immersive. Even so, a distinction needs to be made between immersive training and tailored training. The learner selected choices that drive the situation and prompted the student to "think again" or reselect when their choice proved wrong. The new choice prompted a replay of the situation with varied severity of consequences and results; better decisions mitigated the more negative consequences or proved successful. Immersive training gives the user some control of the emerging storyline the training follows; however, this control does not give the learner control over selecting training to address his or her preferences and needs.

Most products included knowledge check questions. Questions incorporated correct and incorrect feedback. In general, the approach following the presentation of incorrect feedback was as follows. With the first incorrect feedback the learner received a prompt or hint. The question was presented a second time, sometimes the response options were randomized, and in others they remained the same. If the learner, incorrectly responded a second time, the directions told the student to review the content again. This rerouted the learner to the topic beginning. When the learner reviewed previously viewed content, the same question was again presented. Questions could be designed to better target the learners' specific areas of difficulty in learning the material, with less repetition.

Many courses followed a linear sequence even with incorporated animations and question sequences. Learners had to follow the prescribed lesson path until the lesson was completed. There were no options that allowed for individual learning differences and preferences. The content and structure of most IMI courseware appeared focused on a particular structure of presentation for topics, skills, or tasks, a template that was frequently repeated across different

IMI. The design, structure, and sequence guided the learner along a single path of learning to completion without the Soldier being required to do much except select "NEXT" and recall terms or answer simple questions that echoed key points presented in the training. Some courses had animation. However, most had little Soldier interaction beyond answer selection, "NEXT" navigation, and pop-up boxes.

While a few courses allowed a user to navigate to selected sections or topics within the courseware, their primary organization and structure facilitated taking the course from start to finish, rather than focusing on isolated sections or accessing training for only selected knowledge or skills. Few courses were designed to permit rapid navigation to isolated skills, part-tasks, specific knowledge domains, or for a specific point of need. Menus and course maps seldom identified with clarity the task, skill, or knowledge contained in a lesson or module. Menus were not consistent throughout the courses. The specific skill or small kernel of knowledge that the Soldier may require was sandwiched in the middle of a course or distributed throughout multiple lessons.

For learners to acquire or be exposed to their needed knowledge or skills, the IMI reviewed would require the learner to complete the entire course or to access multiple lessons or modules within a course. Few courses were organized to provide a quick familiarization with learner-determined subject or a track to gain core knowledge of domain-specific tasks. At times, the desired skill or knowledge was camouflaged within the courseware; present in the menu, but hidden from easy access by learners. In many cases, the learners would have needed to work through the entire course even if they had already mastered the necessary knowledge or skills contained in sections of the courseware. Proficiency or test-out options were not generally available.

Addressing the IMI Reuse Question

When we initially planned this research effort, we had expected that reuse of existing IMI would expedite our ability to execute modifications to address point of need. We found the reuse process far more complicated than initially anticipated. The issues we encountered are widely recognized in the research literature (for review see 'The SCORM Debate' in VET Learning Object Repository, 2003). Reuse of IMI courseware components is based on the assumption that whole lessons, modules, or SCOs can be broken apart and reassembled in a plug and play fashion. Even if this was possible, this approach would not address how content within a repurposed IMI module could be selected and reshaped to better address a learner's specific needs. Given the difficulties we encountered on a small scale, we believe that any large scale reuse/repurposing of existing IMI programming, graphics, etc., to address point of need may be time and cost prohibitive.[7]

Adapting IMI to Point of Need

Setting aside questions of reuse/repurposing of IMI, we considered ways to implement point of need within IMI more generally. A major consideration when examining the existing

[7] This issue will be addressed in greater detail in a subsequent research report.

IMI was to determine what would be required to incorporate various tailoring principles to address the point of need with an eye toward future development of IMI.

Dyer, Wampler, and Blankenbeckler (2011) identified forms of tailored training, provided examples of tailored training in Army courses, and even offered explanations why selected forms of tailoring might be more applicable to Army training. In our research, we considered a mix of approaches to tailoring IMI. Of the approaches considered, all focused on macro-level adaptations, since there often would not be an instructor present when Soldiers are completing IMI modules. These approaches are described in Table 3.

Table 3
Macro-Level Adaptations to IMI to Address Point of Need

Approach	Description
Preliminary, whole-task evaluation	At the outset of training, Soldiers are asked to complete a scenario-based evaluation over a whole task relevant to the domain to be trained
Provide specific, detailed feedback	Following the whole-task evaluation, Soldiers are provided specific Go/No Go feedback on each of the subtasks covered by the whole-task test.
Allow Soldier to choose among various training options adapted to points of need	Given feedback on their performance, Soldiers are then given the option to pursue additional training to help them (a) better understand concepts relevant to the domain, (b) execute the task, (c) go through a worked example with scaffolding and ongoing feedback on their performance.
Post-training whole-task evaluation, again with specific, detailed feedback	Provide the Soldier with an opportunity to evaluate how well they learned the critical skills taught in the IMI. Here, Soldiers are again presented options to pursue additional training, with each option targeted to their point of need.

Currently, Army institutional training is not usually tailored to student needs, similar to what is seen with most existing IMI (Dyer, Wampler, & Blankenbeckler, 2011). In the classroom, instructors may lack experience in identifying common difficulties students encounter when learning particular tasks and skills. Moreover, instructor preparation courses rarely cover techniques and tools for tailoring course content to students' needs. Course instruction often is given directly from standard lesson plans, with no adjustment for the training audience. Training techniques are seldom altered to the task and/or the knowledge and experience of the training audience (cf. Bickley et al., 2010; Dyer et al., 2000; Leibrecht, Wampler, Goodwin, & Dyer, 2007; Tucker, McGilvray, & Leibrecht, 2009; Wampler, Dyer, Livingston, Blankenbeckler, & Dlubac, 2006; Wampler, James, Leibrecht, & Beal, 2007). While standardized lessons are the norm for Army institutional training, the IMI format presents an opportunity for tailoring, since IMI lessons are most often completed individually. Tailoring techniques that may be infeasible to apply in a classroom setting may in fact be very applicable in an IMI learning context.

For the ALM to be successful, the Army should look for opportunities to apply tailored training techniques across a broad spectrum of training environments, modalities, and materials. Tailoring training should accommodate student preferences for learning while also maintaining

sound learning strategies. One resource to inform the tailoring process is the *First Principles of Instruction* developed by Merrill (2002). The *principles* form an instructional outline created from examining numerous instructional models and theories. Merrill's approach has found support in other instructional design research (see Van Merrienboer & Sweller, 2005; Sweller, Kirschner, & Clark, 2007).

Merrill (2002) determined a small set of principles of instruction are present across good instruction, regardless of type. He describes these principles as interrelated. Further, when these principles are implemented in an instructional program, they resulted in increased quality of instruction and amount of learning. According to Merrill, instruction needs to (a) be task (problem)-centered, (b) activate prior knowledge and experience, (c) include demonstrations of tasks and skills, (d) require learners to apply what they have learned, and (e) encourage learners to integrate their new knowledge into their everyday world. Table 4 provides a descriptive summary of each of Merrill's principles.

Table 4
Merrill's (2002) First Principles of Instruction

Principle	Description	Tailored Training Application
Task (Problem)-Centered	Learning is promoted when learners engage in a task-centered instructional strategy. The task should be a problem that the student may encounter in a real-world situation. This principle lies at the center of the others.	Whole-task focused assessment with detailed feedback to learner about performance on particular aspects of the task.
Activation	Learning is promoted when learners activate prior knowledge or experience. Reminding the learner of relevant previous experience promotes learning by allowing them to build upon what they already know. It may also be important to provide experience when a learner's previous experience is inadequate. This helps to develop useful mental models that are similar in structure to the content being taught, and that help to integrate new information.	Various scaffolding techniques based on testing and/or reported experiences. Presenting templates, mental models, and other cognitively organizing structures throughout the training.
Demonstration	Learning is promoted when learners observe a demonstration of the task or skill. Most effective are simulations, visualizations, and modeling that exemplify what is being taught. Demonstration may include guiding learners through different representations of the same experience through the use of a media, pointing out variations, and providing key information.	Present series of examples and help the learner to derive a generalized mental model. Use ongoing testing, with feedback, to help shape learners' mental models. Target training to learners' specific areas of difficulty.

Table 4 (continued)

Merrill's (2002) First Principles of Instruction

Principle	Description	Tailored Training Application
Application	Learning is promoted when learners apply the new knowledge. This principle requires that learners use their new knowledge in a problem-solving task, using multiple yet distinctive types of practice. The application phase should be accompanied by feedback and guidance that is gradually withdrawn as the learners' capacities increase and performance improves.	Backwards fading. As a learner begins to become proficient with an aspect of a task, remove the instructional supports for that aspect of the task.
Integration	Learning is promoted when learners integrate their new knowledge into their everyday world (mission or job environment). Effective instruction occurs when learners can demonstrate, adapt, modify and transform new knowledge to suit the needs of new situations. Learners may also teach others. Information sharing is important for new knowledge to become part of a learner's personal repertory and for learners' sense of progress. Collaborative work in a group can provide a context for this phase.	Present learners with familiar and novel examples, problems, and applications based on their indicated background experiences and/or testing. Exposure to training material and application problems that contain both familiar and novel elements tailored to learners' needs may help increase longer-term transfer.

The principles described above could serve as the foundation for guiding the tailoring of training during implementation of the ALM more generally, as well as in IMI applications. To address the first principle, IMI could incorporate multiple, complex examples of real-world events and scenarios relevant to the knowledge and skills the IMI addresses. Second, references to previous learning—perhaps indicating the particular level of knowledge and skills an IMI is targeting—could be incorporated. In addition, templates and mental models could be presented to assist the learner in structuring the new information they will be learning in the context of knowledge and experiences they have already had. Third, demonstrations and compelling examples should be used throughout the IMI training. When learners are exposed to multiple contrasting cases/examples, they are better able to derive generalizable principles and establish a mental model for what they are learning (Schwartz & Bransford, 1998). Fourth, as learners progress through the training, they should be encouraged to apply what they have learned to address problem-solving scenarios; with scenarios presented later in training providing fewer contextual cues and learning supports than those presented earlier in training. Finally, the IMI should focus on concrete examples of how the learned knowledge and skills can be integrated into new contexts and situations. It may be helpful to include at least one novel or unexpected application of learned knowledge and skills toward the end of the training to get the learner thinking in terms of longer term transfer of what they have learned.

As stated previously, the IMI lessons we reviewed were generally broad in scope and did not address specific points of need. While lessons and even modules contain useful information and material, the content was generally designed and developed as one-size-fits-all. That is, the IMI was intended to fill several purposes, and was designed to be generally applicable—not to target specific individual needs. Merrill's First Principles (2002) provide an ideal starting point for repurposing or developing IMI for specific points of need. In addition, to receive high student satisfaction, the point of need IMI should: (a) link knowledge and skills to the context of job and mission environments through examples and applications, (b) encourage learners to practice new knowledge and skills, (c) provide learning content in chunks to make locating specific information easier, and (d) engage students in a meaningful learning experience through demonstrations and integration of knowledge and skills with their everyday lives.

Discussion

This was an exploratory research effort focusing on applications of tailored training learning strategies and design techniques to incorporate the ALM's point of need concept into Army IMI. We reviewed a sample of Army IMI from the Maneuver, Fires, and Effects domain, relevant to the specific needs of new Squad/Team Leaders. In this research, we determined a number of relevant learning principles and design techniques that could be employed to support implementation of point of need in Army IMI, although we also found that to implement such principles and techniques using existing Army IMI may be prohibitive on a large scale due to time and cost. Point of need represents a fairly significant divergence from the design philosophies guiding the development of earlier Army IMI, moving as it does from an emphasis on general applicability to an emphasis on the unique particulars of individuals and their learning situations.

Summary of Findings and Recommendations

After reviewing what has been determined from others' efforts to reuse IMI, we were not optimistic that our endeavor would yield a different outcome. Based on our evaluation, most of existing Army IMI likely could not be repurposed for point of need without significant investment in resources and time. However, a number of tailored training learning principles could be applied in future developments of IMI to address point of need challenges and create the flexibility needed for future repurposing or modifications. On the basis of our evaluation and review of a selection of Army IMI for application of the ALM point of need concept, we developed a number of recommendations.

Future point of need IMI should be designed for a well-defined audience and targeted to individual needs. A design philosophy that focuses on developing generally applicable, one-size-fits-all IMI is less applicable in the context of ALM. Shifting to a point of need design philosophy encourages the Army to address both issues of accessibility and the capability of the learning resource to be tailored to individual learners' needs.

Point of need seems to be a matter of striking a balance between predetermining the structure of the IMI content and allowing learners to make self-aware choices about their learning experience. On this basis, specific design features of stand-alone IMI to address point of need may include:

- providing well-structured IMI, with high learner support, and multiple user-selectable learning paths;
- linking knowledge and skills to the job contexts and mission environments through examples and applications;
- encouraging learners to practice new knowledge and skills by focusing on developing mental models and facilitating far transfer;
- providing learning content in smaller, self-contained chunks (a) to make locating particular knowledge and skills an easier task, (b) to facilitate training within the duty day, and (c) to help users form stronger conceptual models of the training domain;
- engaging students in a meaningful learning experience through demonstrations and integration of knowledge and skills with their everyday lives;
- using whole-task pre- and post-assessments to help learners develop higher self-awareness of their level of knowledge and skills with respect to the domain;
- allowing learners greater autonomy in choosing how they proceed through their learning experience—i.e., provide learning paths designed for specific points of need; and
- recognizing that good pedagogy and good content are likely more important than costly high bandwidth multimedia in capturing and maintaining learners' interest and motivation.

Even though IMI should be developed for specific needs, designers should keep potential reuse/repurposing in mind. Learning modules and chunks need to be built for stand-alone use. The component parts (e.g., graphic images, narrations, text files) should be constructed and labeled for easy identification and potential changes. Connections to an LMS should be minimal and a means to locate and alter these hooks/ties should be documented.

Learning design structures. Learning design structure concerns how the overall progress of topics and supporting information is presented in the IMI. In general, we recommend techniques that support well-structured learning designs, rather than open-ended designs. Well-structured learning designs have been found to be more effective and efficient than exploratory designs, which offer little to no guidance to students (Kirschner, Sweller, & Clark, 2006). On this basis, some techniques can be readily incorporated into IMI to reduce cognitive load and support longer-term transfer and problem-solving skills. For instance, learners who practiced skills with guided support (i.e., using worked examples or process worksheets) tended to outperform learners who were left on their own to discover appropriate procedures. In fact, Kirschner and colleagues found that experienced learners tended to gravitate to courses that provided more learning support and guidance, a finding also supported by Straus et al. (2009), Dyer and Salter (2001), and Dyer, Singh, and Clark, 2005. In particular, Dyer, Singh, and Clark found that Soldiers in One Station Unit Training benefited from more structured computer-based training whereas trainees in the Infantry Officer Basic Course

preferred and were better prepared through computer-based training that allowed them to select among various content and training approaches. Dyer and Salter found that chunking information into smaller segments allowed Soldiers to better retain what they had learned as compared to an open-ended, exploratory training format.

However, this does not mean that more open-ended designs—with lower levels of support and guidance—are without application in future IMI development. Discovery learning is most effective when learners have prior experience in a domain. They have already developed an understanding of how things work within that domain, an understanding that then can be applied to make sense of the open-ended problems they are exposed to in the discovery learning format (cf. Dean & Kuhn, 2006). Optimally, the place for open-ended designs would be in blended learning situations in which the IMI is being used to support collaborative learning activities among groups of learners who are supported by a facilitator.

Optimally, it seems, Army IMI should at the appropriate times incorporate both types of design elements to establish knowledge structure (such as direct instruction) and elements to explore and modify preexisting knowledge structures (such as discovery learning, problem-based learning, and other constructivist approaches). Therefore, when tailoring IMI for reuse or developing new IMI, merely offering total flexibility for a student to self-determine how to proceed would not be expected to be as effective as providing a tailored approach that incorporates sufficient structure to support the learning process, yet also gives the student an ability to make informed choices about his or her learning experience. We recommend using scenario-based whole-task evaluation followed with detailed feedback and various learning paths—addressing different points of need—in order to facilitate this type of design structure. With this type of design, students receive both well-structured instruction and learning experiences that can be tailored to their specific needs.

In addition, it should be noted that no matter how well-designed an IMI application is, if students lack motivation, their performance will suffer. Exposing students to whole-task problems before and during instruction—supplementing instruction with part-task practice and supportive information—may serve to motivate students by helping them recognize and want to address their own knowledge and skill deficiencies (Van Merrienboer & Kester, 2007; Van Merrienboer & Kirschner, 2013).

The design elements discussed above can be incorporated into IMI to support implementation of ALM. In particular, IMI can (a) be designed to apply both highly-structured and more discovery-oriented learning approaches depending on the intended context of use, (b) intersperse whole-task and part-task problem solving activities to motivate learners, (c) use task-specific feedback to help learners develop awareness of their learning needs, and (d) include choices among different learning paths to give learners autonomy and control over their learning process, enabling them to address specific points of need. With these design elements, IMI becomes more facilitative and tailored to individual needs, without incurring steep increases in development costs due to incorporation of bandwidth-heavy multimedia features.

Tailored Training Techniques. The described approach to designing IMI for point of need incorporates a variety of longstanding tailored training techniques. These include ability grouping, self-pacing of instruction, and aptitude by treatment interactions.

***Ability grouping*.** In a classroom setting, ability grouping refers to the practice of putting students into groups on the basis of individual group members' ability levels. At times, members of a group may all be of a similar level of ability; other times, students who have lower ability may be grouped with a student(s) of higher ability. After students have been grouped, instruction is tailored to address the particular needs of the group. A similar situation may be addressed in IMI by using pretesting to determine a student's level of ability and then providing training to them that is designed meet needs associated with their particular level of knowledge and/or skills. A posttest with feedback could be included with each tailored IMI module. The posttest is intended to allow the student to assess his or her knowledge after completing the instruction. This allows the student to make an informed decision as to whether he has learned the necessary material, should repeat any of the blocks of instruction, or should consider augmenting his or her understanding by engaging more in-depth learning materials.

***Self-paced instruction*.** Self-pacing allow students to adjust their learning progress to their own speed. While most IMI modules permit students to control their speed, we recommend designing IMI to consist of multiple blocks that vary in depth of instruction. This design feature may offer students increased flexibility in how rapidly they progress through the material. In combination with a pretest and detailed performance feedback, students would be able to choose their own sequence for completing the blocks of training.

***Prior knowledge*.** Another approach to tailoring IMI is to use aptitude-by-treatment interactions, a design feature in which the instructional material is focused on the aptitudes of the learners (Snow, 1989). Students with experience in the IMI module content, i.e., high-prior-knowledge individuals, can select a training path with lower-structure instruction, such as those activities focused on solving a problem. Students with less experience, i.e., lower-prior-knowledge individuals, can select a learning path with more highly-structured instruction, incorporating features such as step-by-step instruction and practice exercises with feedback or worked examples.

The Future of Army IMI

Straus et al. (2011) described what the future of Army IMI may look like. They note that the Army Distance Learning Program (TADLP) funding for developing content has declined in recent years relative to other training accounts. Reduced funding potentially means that implementation of ALM will focus developers on reusing existing IMI and on scaling back development of new IMI. As a consequence, developers are concerned that they will need to develop lower bandwidth courses, sacrificing the latest multimedia features (e.g., videos, complex animation, or high resolution graphics). These features are often viewed as enhancing students' experiences, and consequently, students' interest in what they are learning.

However, Straus et al. (2011) suggested an alternative perspective. What they found was that students were not necessarily more engaged by data-intensive, high bandwidth media; they

were engaged by training that exhibited well-thought-out learning principles, i.e., good pedagogy and good content. The training first has to be carefully designed for learning, and second, for visual appeal. A focus on the structure and flow of information, careful use of part-task and whole-task examples, etc., when developing future IMI may help to improve student engagement, even in an era when there are fewer resources available to dedicate to IMI development.

The ALM points to an expanded role for IMI in Army training and education. To address this expanded role, as noted by Straus et al. (2011), the TRADOC Capabilities Manager for dL (TCM-DL) has outlined plans to change how IMI is developed and delivered, moving from a client-server paradigm—with training delivered on desktop computers—to cloud computing (i.e., services provided via the internet), using mobile learning (mLearning) devices. The TCM-DL has also envisioned a shift from "long courses with protracted development time frames to 'chunked content' that can be developed rapidly" (p. 1).[8] This centralized model of IMI development, storage, maintenance, and distribution could significantly change how the Army develops and uses IMI.

Even so, these issues do tend more toward technical considerations than issues of instructional design and principles of learning. Optimally, what the Army may need is an organizational/delivery structure that directly incorporates labels to indicate point of need content. As IMI is developed by topic and point of need type, it could be incorporated into the organizational/delivery format, e.g., familiarization or core training on "Call for Fire/Adjust Fire for Squad Leaders," or tailored training on "Squad Urban Defense." The different point of need variation could be developed simultaneously as the proponent sees a need for a particular topic, reusing some images, text, etc., between different point of need variations (Jean Dyer, personal communication, 29 May 2013).

What Can Be Reused in Moving to a Point of Need IMI Design?

When conducting this research, we established a standard hierarchy for defining the structure of IMI courseware (i.e., course, lesson, module, and SCO). Using this structure, we found that the greatest efficiencies are gained through the reuse or repurposing of modules or smaller "chunks" of information. Complete lessons were generally broad in scope and did not address any specific needs. Typically the lesson covered more than was necessary for familiarization and lacked the details required for core-type training. Moreover, lessons generally did not have a structure that allowed students to determine how they completed the lesson nor to make informed decisions about what parts of the lessons they might complete. For IMI to address point of need it should be structured in such a way that the learner can easily move through the material to selectively address portions of a course that focus on his or her present learning needs. Current SCOs do not seem to be designed to facilitate this type of movement through the content.

[8] While not explained in the RAND Study (Straus et al., 2011), "chunked content" refers to stand-alone learning modules that can be completed in a short duration. Each module would contain the necessary instructional and assessment materials. Given that each "chunk" is relatively short, these modules could be developed more rapidly than lengthy courses of a much longer duration with expanded content.

With respect to point of need, reuse or repurposing of individual SCOs seemed to provide the least efficiencies. The best way to explain this inefficiency is via an example (see Figure 2). Consider SCOs to be all of the components that go into an automobile (e.g. motor, transmission, tires, seats) as well as the thousands of minor parts (e.g., bolts, wires, cables, gaskets, seals) that are necessary to connect the components and make the entire automobile operate. These components and parts fit perfectly in the existing automobile, because they were chosen, designed, developed, and assembled to fit the specific automobile. However, attempting to remove any one or some of these components for reuse in a different automobile could be quite time consuming and rather ineffective. For example, the transmission might be of a great quality, but is it the right dimension to fit within a different frame, does it have the required gear ratio, and do the mounting bolts synchronize (e.g., location, size, thread count) with the new engine? While the existing automobile and its components work well for its intended purpose, just like existing IMI also works well, when attempts are made to take it apart for reuse, the components most likely will not fit properly. This is especially the case here, where we sought to use IMI designed to reach a broad audience and repurpose it to address the needs of a specific audience or even an individual learner.

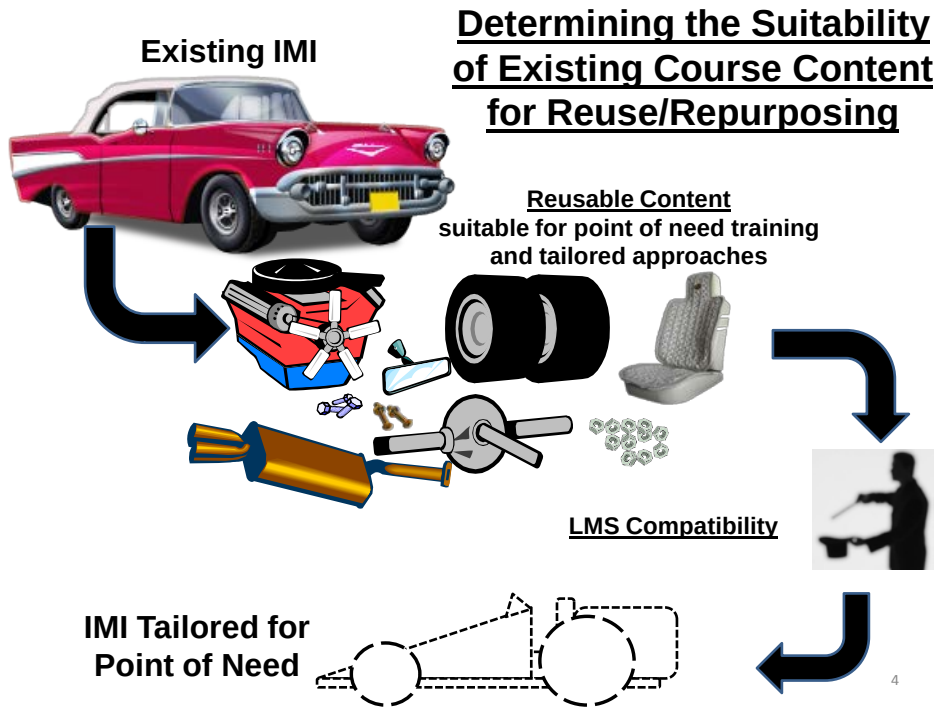

Figure 2. **Can Existing IMI Content Be Reused to Meet Point of Need?**

Even if the components and parts fit, they might not function as intended. Just as the computerized devices and gauges monitor and control automobile functioning, in most existing IMI there is a learning management system (LMS) that is hosting the IMI. This LMS tracks student access, progress, and performance. It also serves as the main controller to have the IMI function properly. When you take IMI components from an existing course, which has LMS-integrated hooks and tracking mechanisms embedded, you must be able to identify these so they

can be removed or changed to function properly in the reused version of the IMI. Even though an existing IMI component might be high-quality, and the LMS controls can be changed, a key question still remains. Does the existing IMI satisfy the *point of need* the new IMI is attempting to address?

The tremendous challenge in trying to reuse existing IMI involves multiple issues. First is the exhaustive search required to locate the potential SCOs to meet the point of need of the new IMI. Then comes the complex challenge of being able to modify the SCO to function properly within the new IMI. Finally, the resultant new IMI must address the desired point of need, which is not what the original IMI was designed to do.

Physical review of IMI content is currently the only method for selection of reusable content. Even though the Sharable Content Object Reference Model (SCORM) has established policies for tagging and identifying reusable objects, there is no centralized repository and no means to search existing IMI courseware to identify potential SCOs to meet very specific points of need. The current method is to conduct a visual and/or audio check of SCOs and pieces. Not only can this be extremely time-consuming and inefficient, but obtaining access to IMI source files where SCOs can be examined might not be possible. While libraries of functioning IMI courseware are accessible, the IMI source files (e.g., SCOs, such as narrations, graphic images, and animations) are often not available. Many times this material must be obtained from the source, the individual or group who developed the IMI prior to the software being compiled.

The preponderance of existing IMI courseware was designed and developed to operate within some LMS. This requires the integration of coding and functionality that is often transparent to the user or viewer of the IMI courseware. However, these codes are built-in to the pages and SCOs of the IMI. When extracting components from existing IMI courseware, care must be exercised to check for these codes and functions. These hidden items can cause the components to operate differently than anticipated and would likely be inconsistent if run in a different LMS. Integrating lessons, modules, chunks, or SCOs into an LMS that differs from the original normally requires some technical modification or tweaking.

Source file availability. Source file availability includes determination if the source files are available and if the text and media files are searchable and extractable. Source files may include access to storyboards and/or the instructional media design package (IMDP) (TRADOC, 2003) which captures the design, conventions and standards, and instructional strategies required by the school, proponent, or supported instructional agency. The IMDP may also include a description of the proposed training program, lesson development support information, and wire-frame diagrams that identify Terminal Learning Objectives (TLOs), Enabling Learning Objectives (ELOs), and SCOs that could support reuse decisions. The IMDP provides insights into the objectives of the designers and authors and may disclose how they intended to employ the media, materials, exercises, and tests to guide learning, convey knowledge, and/or attain desired levels of proficiency or performance. As a minimum, source files should provide original graphics, media, and text files. These source files should be relatable and searchable, supporting efforts to locate and identify files and elements of the existing IMI that may have potential for reuse. Files drawn from executable files on CD-ROM course materials or downloaded from a server across the internet or a network may not have sufficient quality or

resolution for reuse. These files may also be integrated or woven into the LMS of the existing courseware. Such files may not be reusable without further manipulation.

Doctrinal accuracy and currency. Doctrinal correctness and currency are crucial factors. While some military doctrinal principles rarely change, doctrinal terms and tactics, techniques, and procedures (TTP) frequently do. The focus of the operating environment, heavy in counterinsurgency and urban operations, the introduction of new technologies, changes in Army leadership, and greater emphasis on joint and combined operations introduce a number of new or modified terms. A number of TTP can therefore be modified or introduced. These TTP conform to commonly prescribed rules of engagement, incorporate new technologies, emphasize precision room clearing techniques, and the increasing lethality of improvised explosive devices (IEDs).

With each change in TTP or equipment, new training has to be introduced. Some aspects of training will remain unchanged between different variations of equipment, with only minor variations in procedures, etc., becoming relevant with the new equipment. Often, Soldiers will judge the currency and relevance of a piece of IMI or other learning resource based on factors that may not directly reflect the currency of the training content. For instance, training may be viewed as irrelevant if it is being distributed on VHS tapes rather than online or on DVDs. Moreover, it is important to consider how Soldiers may react to images presented within the IMI. For instance, outdated uniforms are a common complaint which leads Soldiers to view the IMI as irrelevant, even if the IMI content is in fact doctrinally accurate and correct. For Soldier acceptance, graphics and visual depictions must show current uniforms and equipment.[9] The appearance of uniforms in IMI other than the current ones adversely dates materials and undermines the courseware credibility. Except when used for contrast or historical examples, doctrine, weapons, equipment, and TTP depicted in IMI need to be current. It is essential to vet materials with current doctrinal references and subject matter experts. Graphics, examples, and illustrations should depict Soldiers in current and correctly worn uniforms with up-to-date equipment.

Suitability for reuse/repurposing. Designers encounter a variety of problems when developing IMI. The interaction one usually has with students in a classroom is not present. Therefore, IMI designers must gauge potential difficulties students may have with the presentation content or style. In fact, for some who are accustomed to writing in a very academic style, transitioning to the more informal tone of IMI can be challenging. While these areas can be overcome when designing and developing IMI from scratch, this becomes a key issue when considering IMI for reuse/repurposing.

Swales' (2000) research provides additional recommendations and guidance to teachers, instructional/course designers, and other education professionals (elementary to university).

[9] For example, the Universal Camouflage Patterned, Army Combat Uniform (ACU) replaced the forest (dark green, black, brown, and dark tan) patterned Battle Dress Uniform (BDU) and desert (light tan, pale green, and brown) and earlier chocolate-chip (light tan, pale olive green, brown, with clusters of black-on-white spots) patterned Desert Camouflage Uniform (DCU) worn in the 1980s and 1990s. Additionally, modified ACU MultiCam, 7-color camouflage pattern, designed to conceal the wearer in varied environments, seasons, elevations, and light conditions has been issued since 2010 to Special Operations Forces and units deploying to Afghanistan.

Swales presented stakeholder groups with "distance education materials" (both paper based and e-learning) for review. The stakeholder groups advised that new or purpose-built materials as well as reused or repurposed materials should be focused on particular audiences. The guidance also encouraged the inclusion of learning activities to assist in breaking the content into suitable learning blocks, a similar finding to that of Dyer and Salter (2001). Further, the materials should encourage and motivate the learner, as well as provide feedback to enable the learner to gauge understanding and progress.

While content and style varied between the courses, much of the existing IMI we examined did not seem easily reusable in a point of need design context. For example, most of the existing IMI we evaluated did not provide examples, did not integrate regular testing to check knowledge at the end of topics, and provided courses or lessons that were general in nature. The IMI tended to follow a "one-size-fits-all" design strategy, rather than focusing on specific topics with an appropriate depth of information tailored to specific points of need. While some parts of existing IMI can be reused or modified, a redesign effort will likely require significant development of new content to address different variations of point of need.

Conclusion

As the Army continues to implement ALM, a distinct shift in the Army's approach to education and training is becoming apparent. One area in which this shift is exemplified is in the design and development of IMI. Much of the existing IMI was designed to be applicable to the broadest possible audience. To develop IMI that is oriented to a learner-centric approach requires the application of point of need concepts and tailored training techniques. These techniques will enhance the ability to address individual differences in learning needs in IMI.

At the outset of this research, we were focused on how to apply point of need concepts and tailored training techniques in existing Army IMI. It became apparent that to accomplish a large-scale revision of Army IMI to address point of need would likely be prohibitive in terms of time and costs. The most reasonable course of action may be to focus on applying point of need and tailored training techniques in the future IMI, at the outset incorporating key principles and techniques into its design.

The approaches we described in this research would present good value to the Army, and more importantly, to Soldiers who are using IMI resources to acquire and maintain their knowledge and skills. The techniques we identified and discussed are not expensive and bandwidth-heavy. The Army should continue to focus its efforts on the hallmarks of carefully-executed design of IMI to enhance learning and to allow Soldiers to engage with IMI in the sequence and depth that they desire. Overuse of bandwidth-heavy multimedia may in fact distract from the key knowledge and skills being taught.

To implement the ALM learner-centric concept, the Army needs to develop IMI that is engaging and designed to give learners both structure and autonomy in their learning experiences. It should also focus learners on evaluating their progress in order to make informed decisions about their own learning needs, and to reflect on their learning process. The principles and techniques we identified in this research support the implementation of the Army's learner-centric model to address individual Soldiers in learning at their point of need.

References

Bell, B. S., & Kozlowski, S. W. J. (2002). A typology of virtual teams: Implications for effective leadership. *Group and Organization Management, 27*, 14-49.

Bickley, W. R., Pleban, R. J., Diedrich, F., Sidman, J., Semmens, R., & Geyer, A. (2010). *Army institutional training: Current status and future research.* (Research Report 1921). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA516971)

Brown, A. (1997). Designing for learning: what are essential features of an effective online course? *Australian Journal of Educational Technology, 13*, 115-126.

Clinton, W.J. (1999). *Using technology to improve training opportunities for federal government employees.* (Executive Order 13111 of January 12, 1999). [Presidential Document, Federal Register, Vol. 64, No. 10, Friday, January 15, 1999]. Retrieved from http://www.gpo.gov/fdsys/pkg/FR-1999-01-15/pdf/99-1185.pdf

U.S. Department of Defense, Advanced Distributed Learning (2011). SCORM 2004: SCORM users guide for instructional designers (4th ed.; Version 8). Accessed online 15 May 2013: http://www.adlnet.gov/wp-content/uploads/2011/12/SCORM_Users_Guide_for_ISDs.pdf

Dyer, J. L., Fober, G. W., Wampler, R., Blankenbeckler, N., Dlubac, M., & Centric, J. (2000). *Observations and assessments of Land Warrior training* (Research Note 2000-04). Alexandria, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA372853)

Dyer, J.L., Wampler, R.L., & Blankenbeckler, P.N. (2011). *Tailored Training in Army Courses*. (Research Report 1950). Arlington, VA: U.S. Army Research Institute for Behavioral and Social Sciences. (DTIC No. ADA552439)

Eberlein, A., & Jiang, L. (2007). Description of a process development methodology. *Software Process Improvement and Practice, 12*, 101-118.

Eiriksdottir, E. & Catrambone, R. (2011). Procedural instructions, principles, and examples: How to structure instructions for procedural tasks to enhance performance, learning, and transfer. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, 53, 749–770. doi: 10.1177/0018720811419154

Fletcher, J.D. (2010). *Research foundations for the advanced distributed learning initiative*. (IDA Document D-4118). Alexandria, VA: Institute for Defense Analyses.

Giglio, K. (2009). Assessment of interactive multimedia instruction (IMI) courseware can enhance Army training. Santa Monica, CA: RAND Arroyo Center. Retrieved from: http://www.rand.org/content/dam/rand/pubs/research_briefs/2011/RAND_RB9622.pdf

Graves, T.R., & Bickley, W. (2009). *Decision process to identify lessons for transition to a distributed (or blended) learning instructional format* (Research Note 2010-02). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA509297)

Graves, T.R., Rauchfuss, G., & Wisecarver, M., (2012). *Self-learning among Army Noncommissioned Officers: experiences, attitudes, and preferred strategies*. (Research Report 1961) Fort Belvoir, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA565313)

Harun, M.H. (2002). Integrating e-learning into the workplace. *The Internet and Higher Education, 4*, 301-310.

Hu, X., Graesser, A., & Fowler, D. (2010). Intelligent tutoring systems. In R. Wisher, P. Jesukiewicz, and B. Kahn (eds.) *Learning on demand: ADL and the future of e-learning*. Washington DC: Department of Defense.

Jones, J.G., & Bronack, S.C. (2007). Rethinking cognition, representations, and processes in 3D online social learning environments. In D. Gibson, C. Aldrick, & M. Prensky (eds.) *Games and simulations in online learning: research and development frameworks* (pp 89-114). Hershey, PA: Information Science Publishing.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. *Applied Cognitive Psychology, 13*, 351.

Kirschner, P.A., Sweller, J. & Clark, R.E. (2006). Why minimal guidance during instruction does not work: An analysis of the failure of constructivist, discovery, problem-based, experiential, and inquiry-based teaching. *Educational Psychologist, 41*, 75–86.

Leibrecht, B. C., Wampler, R. L., Goodwin, G. A., & Dyer, J. L. (2007). *Techniques and practices in the training of digital operator skills* (Research Report 1878). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA474556)

Lipow, A.G. (2003). The future of reference: point-of-need reference service: no longer an afterthought. *Reference Services Review, 31*, 31-35.

Merrill, M. D. (2002). First principles of instruction. *Educational Technology Research and Development, 50*, 43-59.

Metzler-Baddeley, C., & Baddeley, R. J. (2009). Does adaptive training work? *Applied Cognitive Psychology, 23*, 254-266.

Romiszowski, A.J. (1988). *The selection and use of instructional media for improved classroom teaching and for interactive, individualized instruction.* New York, NY: Kogan Page, London/Nichols Publishing.

Shanley, M.G., Lewis, M.W., Straus, S.G., Rothenberg, J., & Daugherty, L. (2009). *The prospects for increasing the reuse of digital training content*. (RAND Study MG-865-A). Arlington, VA: National Defense Research Institute.

Snow, R. E. (1989). Aptitude-treatment interaction as a framework for research on individual differences in learning. In P. L. Ackerman, R. J. Sternberg, & R. G. Glasser (Eds.), *Learning and individual differences: Advances in theory and research* (pp. 13-59). New York: Freeman.

Software Productivity Consortium Services Corp. (1993). *Reuse adoption guidebook.* (Virginia Center of Excellence Technical Report SPC-92051-CMC, Version 02.00.05). Herndon, VA: Virginia Center of Excellence. (DTIC ADA273652)

Straus, S.G., Shanley, M.G., Burns, R.M., Waite, A., & Crowley, J.C. (2009). *Improving the Army's assessment of interactive multimedia instruction courseware* (RAND Study MG-865). Arlington, VA: RAND Corporation.

Straus, S. G., Shanley, M. G., Yeung, D., Rothenberg, J., Steiner, E. D., & Leuschner, K. (2011). *New tools and metrics for evaluating Army distributed learning.* (RAND Study MG-1072-A). Arlington, VA: National Defense Research Institute.

Stoyanov, S., & Kirchner, P. (2004). Expert concept mapping method for defining characteristics of adaptive e-learning: ALFANET project case. *Educational Technology Research and Development, 52*, 41-54.

Stoyanov, S. & Kirchner, P. (2007). Effect of problem solving support and cognitive style on idea generation: implications for technology-enhanced-learning. *Journal of Research on Technology and Education, 40*, 49-63.

Swales, C. (2000). *Editing Distance Education Materials*. The Commonwealth of Learning Knowledge Series, Vancouver, British Colombia. Retrieved from http://www.col.org/resources/publications/Pages/detail.aspx?PID=203

Schwartz, D.L., & Bransford, J.D. (1998). A time for telling. C*ognition and Instruction*, 16(4), 475-522. doi:10.1207/s1532690xci1604_4

Sweller, J., Kirschner, P.A., & Clark, R.E. (2007). Why minimally guided teaching techniques do not work: A reply to commentaries. *Educational Psychologist, 42*, 115-121.

Tucker, J. S., McGilvray, D. H., & Leibrecht, B. C. (2009). *Training digital skills in distributed classroom environments: A blended learning approach.* (Research Report 1893). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA495731)

Trump, J.F., & Tuttle, I.P. (2001). Here, there, and everywhere: reference at the point-of-need. *Journal of Academic Librianship, 27,* 464-466.

U.S. Army Training and Doctrine Command. (2010). *Army learning concept 2015: Thinking Soldiers – Learning Army!* [Video available on secure AKO website]. Retrieved from https://www.us.army.mil/suite/page/647068.

U.S. Army Training and Doctrine Command. (2003). *Training: Multimedia Courseware Development Guide*. (TRADOC Pam 350-70-2). Fort Monroe, VA: Department of the Army, Training and Doctrine Command.

U.S. Army Training and Doctrine Command. (2009). *The Army capstone concept*. (TRADOC Pam 525-3-0). Fort Monroe, VA: Department of the Army, Training and Doctrine Command.

U.S. Army Training and Doctrine Command. (2011a). *The United States Army learning concept for 2015.* (TRADOC Pam 525-8-2). Fort Monroe, VA: Department of the Army, Training and Doctrine Command.

U.S. Army Training and Doctrine Command. (2011b). *The United States Army training concept 2012-2020.* (TRADOC Pam 525-8-3). Fort Monroe, VA: Department of the Army, Training and Doctrine Command.

Van Merrienboer, J.J.G., & Kester, L. (2007). Whole task models in education. In J.M. Spector, M.D. Merrill, J.J.G. Van Merrienboer, and M.P. Driscoll (Eds.), *Handbook of research on educational and communication technology* (3rd ed., pp. 441-456). Mahwah, NJ: Erlbaum/Routledge.

Van Merrienboer, J.J.G., & Kirschner, P.A. (2013). *Ten steps to complex learning* (2nd ed.). New York: Routledge.

Van Merrienboer, J.J.G., & Sweller, J. (2005). Cognitive load theory and complex learning: Recent developments and future directions. *Educational Psychology Review*, *17*, 147-177.

VET Learning Object Repository Project (2003). *Potential benefits and challenges in the use of SCORM in VET.* Commonwealth of Australia: Australian National Training Authority. Retrieved from http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CEUQFjAB&url=http%3A%2F%2Ftoolboxes.flexiblelearning.net.au%2Fdocuments%2Fdocs%2Fkenny.doc&ei=UbEfUrhghcWwBNi9gJAP&usg=AFQjCNEfrMYwNmK9unnknpsj1-pJUD_yrA&sig2=49StcbyaGuO8RROBbij7vg&bvm=bv.51495398,d.cWc

Walsh, A. (2010). QR codes: using mobile phone to deliver library instruction and help at the point of need. *Journal of Information Literacy, 4*, 55-64.

Wampler, R. L., Dyer, J. L., Livingston, S. C., Blankenbeckler, P. N., & Dlubac, M. D. (2006). *Training lessons learned and confirmed from military training research.* (Research Report 1850). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADA446697)

Wampler, R. L., James, D. R., Leibrecht, B. C., & Beal, S. A. (2007). *Assessment of the new Basic Combat Training program of instruction.* (Study Report 2007-06). Arlington, VA: U.S. Army Research Institute for the Behavioral and Social Sciences. (DTIC No. ADB 331403)

Acronyms

ACC	Army Capstone Concept
ACU	Army Combat Uniform
ADA	Air Defense Artillery
ADL	Advanced Distributed Learning
AFQT	Armed Forces Qualification Test
AKO	Army Knowledge Online
ALC	Army Learning Concept
ALM	Army Learning Model
ATN	Army Training (and Education) Network
BDU	Battle Dress Uniform
CoE	Center of Excellence
CORDA	Content Object Repository Registration/Resolution Architecture
DCU	Desert Camouflage Uniform
dL	Distributed Learning
DLDC	Distributed Learning Development Center
DoD	Department of Defense
DOTD	Directorate of Training and Doctrine
ELO	Enabling Learning Objective
FA	Field Artillery
FCoE	Fires Center of Excellence
IED	Improvised Explosive Device
IMDP	Instructional Media Design Package
IMI	Interactive Multimedia Instruction
LCMS	Learning Content Management System
LMS	Learning Management System
MCoE	Maneuver Center of Excellence
MFE	Maneuver, Fires, and Effects
MIMIC	Military Interactive Multimedia Instruction Center
MOS	Military Occupational Specialty
MT2	MyTraining Tab
SCO	Sharable Content Object
SCORM	Sharable Content Object Reference Model
SUGV	Small Unmanned Ground Vehicle

TADLP	The Army Distance Learning Program
TCM-DL	TRADOC Capabilities Manager for dL
TLO	Terminal Learning Objective
TRADOC	U.S. Army Training and Doctrine Command
TTP	Tactics, Techniques, and Procedures
VEILS	Virtual Experience Immersive Learning Simulation

Appendix A

Maneuver, Fires, and Effects Courseware Reviewed

The Maneuver Center of Excellence (MCoE) and the Fires Center of Excellence (FCoE), provided current IMI materials for our examination. These materials included:

- MCoE IMI Courseware
  - United States Army Infantry School (USAIS) Improvised Explosive Device (IED) Defeat Course. Lessons include:
    - Course Introduction.
    - React to a Possible Improvised Explosive.
    - Plan for an Improvised Explosive Device Threat.
    - React to an Improvised Explosive Device Attack.
    - Conduct Tactical Site Exploitation in a Counterinsurgency Environment.
    - Conduct Battle Staff Operations Process in a Counterinsurgency Environment.
  - Total Army Training System 19K Advanced Leaders (TATS 19K ADV LDR) Course, Phase I. Lessons include:
    - Course Introduction
    - Army Aviation
    - Conduct Operations with Attached Infantry
    - Direct Convoy Escort Operations
    - Patrolling Operations with Urban Considerations
    - Cordon and Search (kilo)
    - Conduct a Raid (kilo)
    - Army Writing
    - Army Green
    - Cultural Awareness
    - Counterinsurgency Operations
    - Branch History and Heritage
    - Combat Identification
    - Contemporary Operating Environment
    - Supervise PMCS and Maintenance Forms – Kilo
    - Recognition of Combat Vehicles
    - Conduct an After-Action Review
    - Warrior Transition Unit
    - Training Management
    - Platoon Combatives
  - 19K Military Occupation Specialty – Transition (reclassification training) (19K MOS-T) Course, Phase I (dL). Lessons include:
    - Identify Topographic Symbols on a Military Map
    - Determine the Grid Coordinates of a Point on a Military Map
    - Determine the Elevation of a Point on the Ground
    - Identify Terrain Features on a Military Map
    - Determine a Magnetic Azimuth Using a Compass
    - Orient a Map Using a Compass

- Navigate While Dismounted
- Navigate While Mounted
- Enter a Building During an Urban Operation
- Clear a Building
- Perform Movement Techniques
- Prepare Individual and Crew-Served Positions
- Use Visual Signaling Techniques
- Recognize Armored Vehicles and Aircraft
- Estimate Range
- Operate the Automated Net Control Device
- Operate the Precision Lightweight GPS Receiver
- Operate the Defense Advanced GPS Receiver
- Maintain Operator's Part of Equipment Record Folder
- M1A1 Familiarization (Hull)
- M1A1 Familiarization (Turret)
- Use the M1A1 Operator's Manuals
- Conduct M1A1 Hull PMCS
- Conduct M1A1 Turret PMCS
- Use M1A1 Operator's Controls
- Troubleshoot Using the Driver's Control Panel
- Prepare the Gunner's Station for Operation
- Perform Loader's Before Operation Checks
- Perform Loader's After Operation Checks
- Inspect 120mm Ammunition for Serviceability

o TATS 19D ADV LDR Course, Phase I. Lessons include:
- Course Introduction
- Conduct a Linkup/Relief in Place
- Army Aviation
- Conduct an Area/Zone Reconnaissance
- Direct Convoy Escort Operations
- Patrolling Operations with Urban Considerations
- Cordon and Search (delta)
- Conduct a Raid (delta)
- Army Writing
- Army Green
- Cultural Awareness
- Counterinsurgency Operations
- Branch History and Heritage
- Combat Identification
- Contemporary Operating Environment
- Supervise PMCS and Maintenance Forms – Delta
- Recognition of Combat Vehicles
- Conduct an After-Action Review
- Warrior Transition Unit
- Training Management
- Platoon Combatives

- 19D MOS-T Course, Phase I. Lessons include:
  - Identify Topographic Symbols on a Military Map
  - Determine the Grid Coordinates of a Point on a Military Map
  - Determine the Elevation of a Point on the Ground
  - Identify Terrain Features on a Military Map
  - Measure Distance on a Military Map
  - Determine a Magnetic Azimuth Using a Compass
  - Orient a Map Using a Compass
  - Determine Azimuths Using a Protractor
  - Compute Back Azimuths
  - Navigate While Dismounted
  - Navigate While Mounted
  - Enter a Building During an Urban Operation
  - Clear a Building
  - Perform Movement Techniques
  - Prepare Individual and Crew-Served Positions
  - Select Hasty Firing Positions
  - Direct Vehicle Tactical Movement
  - Conduct an Area Reconnaissance by a Platoon
  - Conduct an Area/Zone Reconnaissance
  - Perform a Reconnaissance by Fire
  - Conduct Actions at a Danger Area
  - Use Visual Signaling Techniques
  - Recognize Armored Vehicles and Aircraft
  - Estimate Range
  - Perform Surveillance Without Electronic Devices
  - Collect Route Classification Data
  - Call For and Adjust Indirect Fire
  - Identify Threat Weapons
  - Operate Night Vision Goggles AN/PVS-7
  - Maintain Night Vision Goggles AN/PVS-7
  - Operate the Automated Net Control Device
  - Operate the Precision Lightweight GPS Receiver
  - Operate the Defense Advanced GPS Receiver
  - Maintain Operator's Part of Equipment Record Folder
- Small Unmanned Ground Vehicle (SUGV) Leaders Course (Training Prototype)
- SUGV Employment for Leaders – Platoon
- Welcome to Jump Master
- Welcome to Path Finder
- A Day in the Bam (a Virtual Experience Immersive Learning Simulation [VEILS ®])
  - Armor Platoon Sergeant Module
  - Infantry Platoon Sergeant Module

- FCoE IMI Courseware – (13F MOS Lessons)
  - Construct a Laser Range Safety Fan
  - Conduct a Suppression Mission

- Conduct an Immediate Suppression Mission
- Conduct Fire for Effect Mission
- Conduct Coordinated Illumination
- Conduct Final Protective Fires
- Conduct Immediate Smoke Mission
- Establish an Observation Post
- Conduct a Mortar Registration
- Request Fire on Irregularly Shaped Targets
- Process Platoon Forward Observer Target List
- Plan Occupation of an Observation Post
- Process Observer Target List
- Clear Indirect Fires
- Engage Targets with Close Air Support (CAS)
- Coordinate Passage of Lines
- Engage a Moving Target with Indirect Fire
- Prepare a Company Fire Support Plan
- Conduct a Highburst Registration
- Engage Targets with Naval Surface Support

Included in the above FCoE lessons modules/lessons are background prerequisite lessons and lessons on foundation tasks and skills that may be required to understand and master the primary lessons. These include:

- Fire Planning
- Threat Recognition
- Determine Target Location
- Call for Fire (Basic)
- Subsequent Corrections
- Prepare a Terrain Sketch
- Fire Support Coordination Measures (FSCMs)
- Laser Safety

Subjects available through the Army Knowledge Online (AKO) newly established MT2 site included:

- Engage Targets During an Urban Operation
- Prepare a Range Card for a Machine Gun
- Perform a Function Check on an MK19 Machine Gun
- Unload an MK19 Machine Gun
- Mount a Night Vision Sight, AN/TVS-5, on an MK19 Machine Gun
- Prepare Positions for Individual and Crew-Served Weapons During an Urban Operation
- Enter a Building During an Urban Operation
- Correct Malfunctions on an MK19 Machine Gun

Appendix B

Initial Criteria for Evaluating Existing IMI

Criterion	Description
Complexity/Depth of Information Presented	Is there sufficient content to provide the desired coverage of the subject area, especially when attempting to form the different points of need training material?
Formal/Doctrinal Correctness (Experts' Perspective)	Is there anything that would raise subject matter experts' and/or trainers' concerns with the currency and accuracy of the material? Are there potential negative transfer issues?
Repurposable Graphics/Images	Are there alternative principles/ideas demonstrated by the same image/graphic? Are the graphics/images contextualized to guide how a Soldier is interpreting them?
Verisimilitude/Face Validity (Learners' Perspective)	Would Soldiers see the information and images presented as being accurate representations of current Army knowledge and practice (e.g., current doctrine, up-to-date uniforms, and current weapon systems)?
Viable Examples	How are examples being used and are there single or multiple examples? Multiple examples may be better to allow Soldiers to generalize principles by deriving consistent patterns across examples (cf. Schwartz & Bransford, 1998).
Narrative Flow	Does the narrative of the training make sense? Do instructional pages that come later logically build on what came before?
Presentation is Focused vs. Diffuse	Do the parts have a clear topical focus, or does the training meander?
Outcome Meets Goal	Does the training reasonably appear to accomplish established goals?
Grouping of Content	Are the modules and information grouped in a way that makes sense and provides a coherent structure (i.e., support development of schemas)?
Appropriate Testing	Do the tests legitimately cover the material at a conceptual level, or are they focused on insignificant details and off the subject area?
Interactivity/Control	In what ways is the Soldier being asked to interact with the training package, materials, etc.? Is the interactivity distracting to or supportive of the overall goals of the training? Is the Soldier given a sense of being able to shape his/her own learning process?
Timing	Would a Soldier be able to develop understanding of one learning point before the next one is presented? Are there logical points at which Soldiers can take a break from what they are learning?
Use of Prior Knowledge	Is prior knowledge elicited or refreshed before it is built upon?

Technical Characteristics	Are the requisite files available and in a format to be able to pull apart the training package? Is the software package that was used in developing the IMI courseware current and useable? Are the respective pieces of the courseware files able to be reconfigured within more current software?
Suitability for Tailoring	Does the courseware include aspects that would support various tailoring techniques (e.g., prompts based on thematic model, structuring presentation of elaborated/basic vs. advanced material, color cuing, pretesting and modifying learning presentation based on performance)